Acceleration in construction and engineering contracts

Champion, Ronan

Acceleration in Construction and Engineering Contracts

A Study of the Management, Economics and Law of Acceleration in Construction and Engineering Contracts

PhD Thesis

Ronan Champion

March 2005

King's College London
Centre for Construction Law and Management

ABSTRACT

Thesis title: Acceleration in Construction and Engineering Contracts

Student: Ronan Champion (95C01266)

This thesis has been prepared for several categories of intended readers: Supervisors, work colleagues and the construction lawyers.

This thesis is centred around acceleration of progress on construction on engineering process, and claims for additional cost arising from accelerative actions taken during the course of projects. Working from first principles, and from some case studies, it analyses and draws into one place a consolidated perspective on acceleration working from the three perspectives of construction management, economics and law.

An underlying reason for this research was that requests for a contractor to accelerate have become more common over the last twenty years, yet little is available in leading texts on acceleration, whether from a management or economic perspective. Similarly, liability for acceleration has tended to be addressed from limited perspectives, Liability issues merited study within a wider perspective, with special consideration of development of the laws of contract (especially consideration for variations to agreements, as seen in *Williams v Roffey*) and the law of restitution.. This thesis draws together and addresses these issues together from a balanced, multi-disciplinary perspective

The research found a number of consistent themes: employers tend to engage contractors on the basis of a single date for completion when their businesses may need some sections of work before others; employers enter into agreements, and variations to agreements with little appreciation of the required state of completion; and employers can be led by contractors toward an expensive acceleration based solutions to projects in delays which exposes the employer to significant risk of time and cost overruns. This can divert from the need to deal with why the delays to progress have been recovered at all. On liability issues, the doctrine of construction acceleration, a creation of US federal court systems, has no place under English law.

In theory these results suggest a more considered approach is required by employers before engaging acceleration solutions. This involves careful consideration of completion requirements and needs, rather than looking alone at a contractors programmes and acceleration proposals. The outcome in practice is that parties should structure acceleration deals to suit their needs, considering management, economics and liability issues. It addition, they should check the merits of defences to acceleration claims, to avoid great risk of outturn costs. The benefit for readers, it is hoped, is to provide an appreciation of what drives and finances acceleration, and areas of potential liability, helping to inform considered analytically based

Some areas remain unresolved. One area, beyond the scope of this study, is a detailed analysis of acceleration within complex subcontracting arrangements. Equally, application of risk management based decision-making has not been considered. Finally, a detailed study of treatment of acceleration before the US courts was also thought to be beyond the course end date. The thesis follows law as it stood at June 2004.

Acknowledgements

Research and preparation of this thesis would not have been possible without the help and support of a number of people: Linda Jones and Sue Hart for their help with administrative matters and use of the library; Supervisors John Barber and Philip Britton for their unstinting support and guidance; the librarians at the Institute of Advanced Legal Studies, Library of the Inner Temple and Royal Institution of Chartered Surveyors in London; work collegues with whom issues were discussed and finally my family, especially my wife Amanda and daughters Madeleine and Lavinia.

TABLE OF CONTENTS

Table of Cases

Australia

Canada

England & Wales

Ireland

United States

Table of Statutes

England & Wales

Supreme Court of Judicature Act 1873

Sale of Goods Act 1893

Supreme Court of Judicature (Consolidation) Act 1925

Sale of Goods Act 1979

Housing Grants, Construction and Regeneration Act 1996

United States

Federal Contracts Disputes Act 1978

Wunderlich Act

Contract Disputes Act of 1978 41 U.S.C. 601-613

BIBLIOGRAPHY:

Books/Articles

Adams, A. and Brownsword, R. (1990) "Contract, Consideration and the Critical path" 53 MLR 536

Aivazian, Trebilcock and Penny (1994) "The law of contract modifications: the uncertain quest for a benchmark of enforceablility" (1984) 22 Osgoode Hall LJ 173

Alkass, S., Mazerolle, M., Tribaldos, E. and Harris, F., (1995) "Computer aided construction delay analysis and claims preparation", Construction Management and Economics, 1995, 13, 335- 352

Allam, S.I.G., (1988) "Multi-project scheduling: a new categorisation for heuristic scheduling rules in construction scheduling problems", Construction Management and Economics, 1988, 6, 93-115

Anderson, Bickford-Smith, Palmer and Redmond-Cooper, Emden's Construction Law, Butterworths.

Arditi, D. and Patel, B.K., (1989) "Impact analysis of owner directed acceleration" Journal of Construction Engineering and Management, Vol 115, no. 1, March 1989, ASCE

Ashworth, A., (1987) "The computer and the estimator", Technical Information Service Paper No.81, Chartered Institute of Building

Atiyah, (1982) "Economic Duress and the overborne will" 98 LQR 197

Atkinson D (1997) "Constructive Acceleration, Disruption and Overheads", published at www.atkinson-law.com

Baird, A., (1994) "The New Engineering Contract - A management summary for Plant industry users", [1994] 11 ICLR 114

Baker & McKenzie Australia, (2002) Construction Law Update July 2002

Barnes, Dr M., (1996) "The New Engineering Contract - an update", [1996] 13 ICLR 89

Bates, R. (2001) "A study of constructive acceleration and its relationship to a claim for uneconomic working", MSc Dissertation, Centre of Construction Law and Management, King's College London.

Battikha, M.G., and Davidson, C.H., (1996) "Cause and effect 3-D model for measuring performance in construction performance in construction acceleration: a decision support system", Building Research and Information, volume 24, number 6, (0961-3218) E&FN Spon.

Baxendale, A.T. and Schofield, T.J., (1996) "Planning and progressing project variations - A building case study", The organisation and Management of Construction: Shaping theory and practice (volume two), edited by Langford, D.A and Retik, A., E&FN Spon

Baxendale, A.T., (1985) "Measuring site productivity by work sampling", Technical Information Service, Paper No. 55, Chartered Institute of Building.

Beatson J, (1991) "Duress, Restitution and Contract Renegotiation" in Beatson's The Use and Abuse of Unjust Enrichment at page 95.

Bennett, J., (1983) "Project management in construction", Construction Management and Economics, 1983, 1, 183-197.

Berkeley D., Humphreys, P.C. and Thomas, R.D. (1991) "Project risk action management", Construction Management and Economics, 1991, 9, 3-17

Bigwood R (2001) "Economic Duress by (threatened) breach of contract" 117 LQR 376

Birkby G (2002) "Acts of Prevention" Construction Law, January/February 2002.

Birks P (1990) "The Travails of Duress" [1990] LMCLQ 342

Blomberg, I., (1988) "The impact of overtime on construction", Transactions of the American Association of Cost Engineers, H3.1-3.5

Bramble, B.B. and Callahan, M.T., (1987) Construction Delay Claims, Construction Law Library, John Wiley & Sons.

Buchan, R.D., (1991) Estimating for Building and Civil Engineering Works, Butterworths, London.

Byrne, The Hon D., (1995) "Total costs and Global Claims", [1995] 12 ICLR 531

Callahan, M.T. (1991) "Disruption Analysis", Conference on Quantification of Building Claims, 20 June 1991, Construction Law division, IBC Legal Studies and Services Ltd.

Callahan, M.T. and Hohns, H.M., (1983) Construction Schedules, The Mitchie Company, Charlottesville, Virginia.

Carter JW, Phang A, Poole J (1995) "Reactions to Williams v Roffey" 8 JCL 248

Chapman, C.B., and Ward, S., (1997), Project Risk Management, John Wiley & Sons.

Chartered Institute of Building, (1981) Programmes in construction, a guide to good practice, Chartered Institute of Building, UK.

Chartered Institute of Building, (1987) Code of Estimating Practice No.1 - Refurbishment and Modernisation, Chartered Institute of Building, UK.

Chartered Institute of Building, (1988) Code of Estimating Practice No.2 - Design and Build, Chartered Institute of Building, UK.

Chartered Institute of Building, (1988) Project Management in Building, 2nd edition, Chartered Institute of Building, UK.

Chartered Institute of Building, (1996) Code of Practice for Project Management for Construction and Development, 2nd Edition, Longman.

Chen Wishart, M. (1994): "Consideration, practical benefit and the Emporer's new clothes" published as Chapter 5 in Good Faith and Fault in Contract Law, by Beatson.

Cherns, A.B. and Bryant, D.T., (1984) "Studying the Client's role in construction management", Construction Management and Economics, 1984, 2, 177-184

Cooke, B and Williams, P (1998) Construction Planning, Programming and Control, Macmillan Press, London.

Coote, A. (1980) "Duress by threatened breach of contract" [1980] CLJ 40

Cornes, D. L., (1996) "The Second Edition of the New Engineering Contract", [1996] 13 ICLR 97

Cox, Prof. A., and Thompson, I., (1996) "Is the NEC going to succeed - An examination of the Engineering and construction contract (alias the NEC 2nd Edition) ", [1996] 13 ICLR 327

Cuneo, G.A. and Ackerly, R.L., (1975) "Delays, Suspension, Acceleration", Government Contracts Monograph No. 9, Government Contracts Program, The George Washington University.

Cusack, M.M., (1985) "A simplified approach to the planning and control of cost and project duration", Construction Management and Economics, 1985, 3, 183 -198

Davis, M.E., (1996) "A Brief Presentation of the Construction of a Waste Treatment Plant from the Lender's Perspective", (1996) 12 Const.L.J. Page 218-

De Zylva, M.O., (1997) "Towards a Common Law: The difficulty of Harmonising International Construction", (1997) 13 Const.L.J., 107

Dorter J (2001) "Delay and Disruption" 17 BCL 372

Dorter J (2002) "The effect of Contract Clauses on Claims for Delay and Disruption" [2002] ICLR 312

Dorter, J., (1991) "Variations", (1991) 7 Const.L.J., 281

Duncan Wallace Q.C., I., (1991) "Beyond the Contractor's Control" (1991) 7 Const.L.J., 3

Duncan Wallace, I.N., (1969) Building and Civil Engineering Forms, Sweet & Maxwell

Duncan Wallace, I.N., (1970) Hudson's Building and Engineering Contracts, 10th Edition, Sweet & Maxwell

Duncan Wallace, I.N., (1973) Further Building and Civil Engineering Forms, Sweet & Maxwell

Duncan Wallace, I.N., (1986) Construction Contracts: Principles and Policies in Tort and Contract Volume 1, Sweet & Maxwell, London

Duncan Wallace, I.N., (1988) Hudson's Building and Engineering Contracts, 11th Edition, Sweet & Maxwell

Duncan Wallace, I.N., (1996) Construction Contracts: Principles and Policies in Tort and Contract Volume 2, Sweet & Maxwell, London

Edwards, B. and Eckland, J., (1984) "Motivating the British construction industry", Construction Management and Economics, 1984, 2, 145-156

Eggleston, B., (1997) Liquidated Damages and Extensions of Time in Construction Contracts, 2nd Edition, Blackwell Science

Elliott, T., (2000) "The acceleration game", Building Magazine, 19 May 2000.

Ersoz, H.Y., and Halpin, D.W., (1996) "A new approach to productivity estimation", The organisation and Management of Construction: Shaping theory and practice (volume two), edited by Langford, D.A and Retik, A., E&FN Spon

Farrow, T. (1991) "Acceleration: facing the dilemmas", Chartered Quantity Surveyor, RICS

Farrow, T. (1991) "Acceleration: the agreement", Chartered Quantity Surveyor, RICS

Fazio, P., Moselhi. P., Theberge, P. and Revay, S., (1988) "Design impact of construction fast-track.", Construction Management and Economics, 1988, 6, 195-208

Fellows, R.F., (1989) "The management of risk", Technical Information Service Paper No.111, Chartered Institute of Building

Furuya, K., (1993) "ENAA revised model form of contract (1992) Edition", [1993] 10 ICLR 5

Galbraith, J.R., (1995) Designing Organisations, Jossey-Bass Publishers, San Francisco

Gates, M. and Scarpa, A., (1972) "Learning and Experience Curves", Proceedings of the American Society of Civil Engineers, Journal of the Construction Division, 98, CO1, March, 79-99

Geddes, S. & Chrystal-Smith, G. (1985) Estimating for Building and Civil Engineering Works, 8th Edn, Butterworths, UK.

Gould, N., (1994) "Comments on the ENAA Model Form International Contract for process plant construction (revised 1992) ", [1994] 11 ICLR 498

Grimm, C.T and Wagner, N.K. (1974), "Weather effects on masonry production", Proceedings of the American Society of Civil Engineers, Journal of the Construction Division, 100, CO3, Sept, 319-335

Guest, A.G. and others, (1994) Chitty on Contracts, 27th Edition, London, Sweet & Maxwell.

Halson, R. (1990) "Sailors, Subcontractors and Consideration" 106 LQR 183

Halson R (1991) "Opportunism, Economic Duress and Contractual Modifications" 107 LQR 649

Haltenhoff, C.E., (1986) "Comprehensive use of construction scheduling", American Professional Constructor, January 1986, American Institute of Constructors.

Hambridge, B.W., (1982) "Productivity, time and cost", Technical Information Service, Paper No. 10, Chartered Institute of Building.

Hardie, G.M., (1987) Construction Estimating Techniques, Prentice-Hall.

Harris, F. and McCaffer, R., (1995) Modern Construction Management, 4th Edition, Blackwell Science

Harrison, F.L., (1981) Advanced Project Management, Gower, UK

Harrison, R.S., (1987) "Managing the estimating function" Technical Information Service Paper No.75, Chartered Institute of Building

Herbsman, Z. and Ellis, R., (1990) "Research of factors influencing construction productivity", Construction Management and Economics, 1990, 8, 49-61

Hillebrandt, P.M. and Meikle J.L., (1985) "Resource planning for construction", Construction Management and Economics, 1985, 3, 249- 263

Holt, L., (1989) "Project management excelence: the Shell Stanney case", Construction Management and Economics, 1989, 7, 217-234

Horgan, M.O'C. and Roulston, F.R., (1988) Project Control of Engineering Contracts, E&FN Spon

Horner, R.M.W. and Talhourni, B.T., "Effects of Accelerated Working, delays and disruption on labour productivity", Chartered Institute of Building.

Horner, R.M.W., (1982) "Productivity, the key to control", Technical Information Service, Paper No. 6, Chartered Institute of Building.

Horner, R.M.W., Talhourni, B.T. and Whitehead, R.C. (1987), "Measurement of factors affecting labour productivity on construction sites", Proceedings CIB W-65 5th International Symposium on organisation and management of construction, Vol 2, London, Sept, 669-680

Hoshi, H., (1997) "ENAA Model Form of Contract for Power Plant Construction", [1997] 14 ICLR 61

Hosie, J., "Liquidated and Unliquidated Damages", (1994) 10 Const.L.J., 214-224

Houghton A., "Milestones and Liquidated Damages", (1992) 8 Const.L.J. 232-239

Householder, J.L. and Rutland, L.E., (1990) "Who owns float", Journal of Construction Engineering and Management, Vol 116, no. 1, March 1990, ASCE.

Hughes, G.A. and Barber, J.N., (1992) Building and Civil Engineering Claims in Perspective, Pearson Professional Education

Hughes, W. and David Greenwood, D., (1996) "The standardisation of contracts for construction", [1996] 13 ICLR 198

Hughes, W.P., (1994) "Improving the relationship between construction law and construction management", International confernece: Charting the course to the year 2000- Together; The first multidisciplinary conference on co-operative creative problem solving in the construction industry, University of Kentucky, USA.

ICE and Institute of Actuaries, (1998) Risk Analysis and Management for Projects, Thomas Telford

Ireland, V., (1985) "The role of managerial actions in the cost, time and quality performance of high-rise commercial building projects", Construction Management and Economics, 1985, 3, 59-87

Jaynes, G.L., (1993) "Turnkey Contracts: Japan's Model Forms", [1993] 10 ICLR 251

Jenkins, J. and Ryder, D., (1995) "In search of the Holy Grail (or how to Escape a Lump Sum Price: An Analysis of English and French Law) ", [1995] 12 ICLR 240

Jensen, D.A., Murphy, J.D. and Craig, J., "Recognising the necessary legal elements for a sucessful construction acceleration claim", ?? [publication unknown]

Jones, D.S., (1996) "Philosophies of Risk allocation - the case for Foreseeability, [1996] 13 ICLR 570

Jones, G.W., (1992) "Construction Contractors: The right to stop work (Part II) ", [1992] 9 ICLR 433

Jones, G.W., (1992) "Construction Contractors: The right to stop work", [1992] 9 ICLR 310

Karnt, R., (1987) "A systematic approach to stochastic scheduling", Construction Management and Economics, 1987, 5, 187-198

Karshenas, S. and Haber, D., (1990) "Economic optimisation of construction project scheduling", Construction Management and Economics, 1990, 8, 135-146

Keating D., (2002) Keating on Building Contracts, 7th Edition, London, Sweet & Maxwell

Keating, D., (1995) Keating on Building Contracts, 6th Edition, London, Sweet & Maxwell.

Keating, D., (1995a), "Alwyn Waters Memorial Lecture: The Making of a Standard Form" (1995) Const.L.J., 170

Knutson, R., (1997) "Common Law development of the Doctrines of impossibility of performance and frustration of contracts and their use and application in Long-term concession Contracts", [1997] 14 ICLR 298

Koehn, E., Seling, F. and Kuchur, J. (1978), "Costs of delays in construction", Proceedings of the American Society of Civil Engineers, Journal of the Construction Division, 104, CO3, Sept, 323-331

Kumaraswamy, Mohan M., (1997) "Common Categories and Causes of Construction Claims", (1997) 13 Const.L.J., 21

Lal, H (2002) "Extensions of Time: the conflict between the prevention principle and notice requirements as a condition precedent" published by SCL in April 2002.

Lane, M., (1992) "FIDIC 4th Edition and English Legal System", [1992] 9 ICLR 291

Lane, N., (2000) "Constructive Acceleration" (2000) 16 Const.L.J No. 4, 231 - 241

Laufer, A. (1991) "Construction planning in uncertain environments", Project Management, Vol 9 No. 1 February 1991, Butterworth-Heinemann Ltd.

Laufer, A. and Tucker, R.L., (1987) "Is construction project planning really doing its job? A critical examination of focus, role and process", Construction Management and Economics, 1987, 5, 243-266.

Laufer, A. and Tucker, R.L., (1988) "Competence and timing dilemma in construction planning", Construction Management and Economics, 1988, 6, 339-355

Lester, A., (1982) Project Planning and Control, Butterworth Scientific, 1982

Levine M.F. and Williams, J.H., (1992) "Restitutionary Quantum Meruit- The Crossroads", (1992) 8 Const.L.J., 244

Lewis, S., (2001) "Life in the fast lane", Building Magazine, 01 June 2001

Lewis, T.M. and Atherley, B.A., (1996) "Analysis of construction delays", The organisation and Management of Construction: Shaping theory and practice (volume two), edited by Langford, D.A and Retik, A., E&FN Spon

Lloyd, H. (1996) "Prevalent philosophies of risk allocation - an overview", [1996] 13 ICLR 502

Lloyd, H. (1996) "The new ENAA Model form of Contract", [1996] 13 ICLR 482

Lock, D., (1996) Project Management, 6th edition, Gower, London.

Lowe, J. G., (1987) "The measurement of productivity in the construction industry", Construction Management and Economics, 1987, 5, 101-113

Lyden, J.M.E., (1991) "The Law and Practice of Extensions of Time", (1991) 9 Const.L.J., 16

Mastrandrea, F., (1986) "The liability of the construction project manager", Construction Management and Economics, 1986, 4, 105-134

Matheou, M., (1992) "Minimum Liquidated Damages- Should the Decision of the High Court in Hong Kong be Torpedoed?" (1992) 8 Const.L.J., 25

Mawdesley, M., Askew, W. and O'Reilly (1997) Planning and Controlling Construction Projects, The Chartered Institute of Building and Addison Wesley Longman, UK

McCaffer, R. & Baldwin, A.N. (1991) Estimating and Tendering for Civil Engineering Works, 2nd edition, Blackwell Scientific Publications, UK

McFillen, J.M. and Maloney, W.F., (1988) "New Answers and new questions in construction worker motivation", Construction Management and Economics, 1988, 6, 35-48

McKendrick, E. (1995), Force Majeure and Frustration of Contract, 2nd edition

Megens, P., (1997) "Construction risk and Project Finance - Risk allocation as viewed by contractors and financiers", [1997] 14 ICLR 5

Morris, M., (1990) "Good planning is the key", Chartered Builder, December 1990, Chartered Institute of Building.

Morris, P.W.G., (1994) The Management of Projects, Telford, London

Murdoch J., (1991) "Contractual overruns and Extensions of Time", (1991) 8 Const.L.J., 32

Nahapiet, H and Hahapiet, J., (1985) "A comparison of contractual arrangements for building projects", Construction Management and Economics, 1985, 3, 217-231

Ndekugri, I.E., (1988) "Sub-contractor control - the key to successful construction", Technical Information Service Paper No.98, Chartered Institute of Building

Noble, A., (1997) "Contractors' and subcontractors' constant best endeavours to prevent delay", (1997) 13 Const.L.J., Page 293

Nolan D (1999) "Economic Duress and the Availability of a Reasonable alternative" [1999] RLR 105

NPWC and NBCC, (1990) No Dispute, National public works conference and National building and construction council, Australia

O'Reilly, M., (1995) "Risk, Construction Contracts and Construction Disputes", (1995) 11 Const.L.J., 343

Olgivie M, (1981) "Economic Duress, Inequality of Bargaining power and Threatened Breach of contract" 26 McGill LJ 289

Olomolaiye, P.O., (1990) "Motivation and Productivity of bricklayers", Technical Information Service Paper No.115, Chartered Institute of Building

Oxley, R. and Poskitt, J. (1987) Management Techniques applied to the Construction Industry, 4th edition, Blackwell Scientific Publications, UK.

Pain, J. and Bennett, J., (1988) "JCT with Contractor's Design form of contract: a study in use", Construction Management and Economics, 1988, 6, 307-337

Peel, E. (1994) "Part payment of a Debt is not consideration." 110 LQR 353

Phang, A. (1990) "Whither Economic Duress? Reflections on two recent cases" (1990) 53 MLR 107

Phang, A. (1991) "Consideration at the Crossroads" 107 LQR 21

Phang, A. (1992) "Economic Duress – Uncertainty confirmed" (1992) 5 JCL 147

Pickavance, K., (1997) Delay and Disruption in Construction Contracts, LLP, London.

Pike, A., (1991) "Review of the Fidic conditions of contract for Electrical and mechanical works, Third Edition 1987. ", [1991] 8 ICLR 415

Pilcher, R. (1992), Principles of Construction Management, McGraw-Hill.

Pirie J.D., (1995) "Contractual Problems connected with Major Infrastructure Projects", [1995] 12 ICLR 213

Pitney, A. and Smith, C., (1996) "Public Transport Systems: The Allocation of Risks in Construction Contracts", (1996) 12 Const.L.J., 240

Ponce de Leon, Dr G., (1982) "Float Ownership - Some Recommendations", Project Management Associates Inc., October 1982

Ponce de Leon, Dr G., (1983) "Activity Float Entitlement", Project Management Associates Inc., Fall 1983.

Potter, D and Scions, D., (1982) "Computer-aided estimating", Technical Information Service Paper No.7, Chartered Institute of Building

Powell Smith, Dr. V., (1991) "The Government General Conditions of Contract for Building and Civil Engineering- Edition 3", (1991) 7 Const.L.J., 24- 44

Price, A.D., (1991) "Measurement of construction productivity: concrete gangs", Technical Information Service Paper No.128, Chartered Institute of Building

Rad, P.F., (1980) "Analysis of working space congestion from scheduling data", Transactions of the American Association of Cost Engineers, 24th Annual Meeting, Washington, July, F4.1-4.5

Rembert Meyer-Rochow (1997) 71 ALR 532 "The requirement of consideration"

Revay, S.G., (19) "Can construction claims be avoided- Part II", ??

Riad, N.I. and Arditi, D. (1989) "Expert Systems - Construction Management, An Overview of a reent relationship", First carribean Conference on Artificial Intelligence

Riad, N.I., Arditi, D. and Mohammadi, J. (1989) "MODA - An expert system for managing owner directed acceleration", First Caribbean Conference on Artificial Intelligence

Richter, I.E., (1983) International Construction Claims: Avoiding and Resolving Disputes, New York McGraw-Hill

Ritz, G.J., (1994) Total Construction Project Management, New York, McGraw-Hill

Robertson A (2000) "Reliance, Conscience and the New Equitable Estoppel" [2000] MULR 7; (2000) 24

Seppala, C.R., (1995) "The new FIDIC International Civil Engineering Subcontract", [1995] 12 ICLR 5

Shtub, A., (1988) "The integration of CPM and material management in project management", Construction Management and Economics, 1988, 6, 261-272

Sidwell, A.C., (1990) "Project Management: Dynamics and performance", Construction Management and Economics, 1990, 8, 205-218

Skitmore, R.M., Stradling, S. G. and Tuohy, A.P., (1989) "Project management under uncertainty", Construction Management and Economics, 1989, 7, 103-113

Smith G (2002) "The 'Prevention Principle' and conditions precedent: recent Australian developments" [2002] ICLR 397

Smith S (1997) "Contracting under pressure: a theory of duress" [1997] 56 CLJ 343

Smith SA (1999) "Concurrent liability in Contract and Unjust Enrichment: the fundamental breach requirement" (1999) 115 LQR 245

Smith, R.J., (1996) "Allocation of risk - the case for manageability", [1996] 13 ICLR 549

Stein's Construction Law, Matthew Bender & Co., New York

Stipanowich, Thomas J, (1988) "Review Article. Sweet on Construction Industry Contracts. Major AIA documents", (1988) 4 Const.L.J., 21- 28

Sweet, J. (2002) "Contract regulation of delay and disruption claims in America" [2002] ICLR 284. This article refers to NDC or No Damage Clauses

Sweet, J. (1991) "Standard Construction Contracts: Some Advice to Construction Lawyers" (1991) 7 Const.L.J., 8- 23

Sweet, Prof. J., (1994) "Judging Contracts: Some reflections on the Third International Construction Law Conference", [1994] 11 ICLR 413

Tan D (2002) "Constructing a Doctrine of Economic Duress" (2002) 18 Const.LJ 87 - 96

Taner, N. and Russell, A.D. (1981) "Labour Productivity and cost escalation in large projects", Proceedings of the CIB W-65 3rd International Symposium on organisation and management of construction, Ireland, July, B1.27-1.44

Thomas, R. and Dunbar, I., (1995) "Extensions of Time- Delays After the Completion Date", (1995) 11 Const.L.J., 7

Turner, J.R. (1992) The Handbook of Project Based Management: Improving Processes for Improving Strategic Objectives. New York, McGraw-Hill

U.S. Army Corps of Engineers, (1987) Modifications and claims guide, EP 415-1-2, Office of the Chief of Engineers, Department of the Army.

Uff, J. (1991) "Standard Contract Terms and the Common Law", (1993) 9 Const.L.J 108- 116

Uff, J. and Capper, P., (1989) Construction Contract Policy, Centre of Construction Law and Management, Kings College London.

Uff, J. and Odams, M.A., (1995) Risk, Management and Procurement in Construction, Centre of Construction Law and Management, King's College London.

Uprichard, D.C., (1986) "Computerised standard networks in tender planning" Technical Information Service Paper No.59, Chartered Institute of Building

Valentine, D. G., (1992) "How Not to Draft a Contract", [1992] 9 ICLR 526

Valentine, D. G., (1992) "The ICE 6th Edition- An Opportunity Bungled", [1992] 9 ICLR 509

Valentine, D. G., (1996) "The New Engineering Contract Part 3: Late Completion and Liquidated Damages", (1996) 12 Const.L.J., 326-

Valentine, D. G., (1996) "The New Engineering Contract Part 1: a New Language", (1996) 12 Const.L.J., 305-

Valentine, D. G., (1996) "The New Engineering Contract Part 2: Claims for Extensions of Time", (1996) 12 Const.L.J., 313-

Verschuren, C.P., (1984) "Effects of repetition on the programming and design of buildings", Proceedings CIB W-65 4th International Symposium on organisation and management of construction, Waterloo, 651-661

Vickery, A.B., (1990) "Construction Management- Intractable problems?", (1993) 9 Const.L.J 87

Wakame, N., (1995) "An Overview of major issues on ENAA Model Form International Contract for Process Plant Construction.", [1995] 12 ICLR 98

Walker, A. and Hughes, W.P., (1984) "Private industrial project management: a systems-based study", Construction Management and Economics, 1984, 2, 93-110

Walker, A. and Hughes, W.P., (1986) "A conventionally - managed project: a systems-based study", Construction Management and Economics, 1986, 4, 75-79

Walker, A. and Hughes, W.P., (1987) "A project managed by a multi-disciplinary practice: a systems-based study", Construction Management and Economics, 1987, 5, 123-140

Walker, A.W., (1996) Project Management in Construction, 3rd Edition, Blackwell Science

Wallace IND (2002) "Blinding with Science? Extension of Time and Compensation "Protocol": a critique". Construction and Engineering Law Volume 7, Issue 2 at page 7

Wallace IND (2002) "Liquidated Damages 'Down Under': Prevention by Whom?" 7 CEL 56

Wallace IND (2002) "Prevention and Liquidated Damages: A theory too far?" 18 BCL 82

White, A., (1985) "The critical path method and construction contracts: a polemic", Construction Management and Economics, 1985, 3, 15-24

White, A.M., (1985) "The critical path method and construction contracts, a polemic", Chartered Builder, The Australian Institute of Building

Wickwire, J.M. and Smith, R.F., (1974) "The use of Critical Path Method Techniques in Contract Claims", Public Contract Law Journal, 7, 1, 1- 45

Winch, G., (1989) "The construction firm and the construction project: a transaction cost approach", Construction Management and Economics, 1989, 7, 331-345

Winter J (2002) "Extensions of Time – Notice as a Condition Precedent to Entitlement" Baker & McKenzie Legal Briefing

Winter J (2002) "Time at Large", Baker & Mckenzie

Winter, J.B., (1997) "The FIDIC Conditions of Subcontract and the UK FCEC "Blue Form" of Contract", [1997] 14 ICLR 5

Wiwen-Nilsson, T., (1994) "A brief review of the 1992 Edition of the ENAA Model Form - international contract for process plant construction (Turnkey Lump Sum basis)", [1994] 11 ICLR 526

Wiwen-Nilsson, T., (1997) "The 1996 Edition of the ENAA Model Form - International Contract for Power Plant Construction - A brief Review", [1997] 14 ICLR 273

Wright, D., (1994) "A "Fair" set of Model Conditions of Contract - Tautology or impossibility?", [1994] 11 ICLR 549

Xavier, G., (1998) "Contractors' obligations in a Malaysian Construction Contract", (1998) 14 Const.L.J., No. 2, Page 83

I. Introduction

A. *Background to this study*

Personal observation from practice as a Chartered Quantity Surveyor, and in particular sixteen years spent in evaluation of time and quantum on construction disputes, revealed references to 'acceleration' of project progress. It revealed references to "acceleration agreements" whereby the contractor agreed to alter the way work was to be completed, or complete by a date earlier than would have otherwise been the case. It revealed claims made by contractors to recover costs said to have been incurred in accelerating. More often, delays were incurred as projects progressed, delays that the employer could not tolerate. The contractor, architect, project manager or engineer proposed accelerating progress as a means of recovering. Occasionally, contractors voluntarily altered the pace of their work and sought recovery of additional costs incurred on the basis that work had been accelerated.

Typically, from observation, implementation of acceleration was fraught with difficulty and uncertainty. One difficulty was the shortage of time for the parties to agree and record what 'acceleration measures' might be taken for the project's delays to be recovered. Parties differed over the form in which instructions to accelerate might be recorded. They differed over the existence of contractual powers to order acceleration, whether expressly or tacitly; they differed over the likely cost and over responsibility for earlier and later delays. These differences resulted, more often than not, in significant disputes between the parties that continued for months, even years, after the project was completed. Disputes arose from the failure of acceleration measures to achieve the aims expected by one or more parties, from misgivings over whether any value was derived from payment of sums to contractors in return for the performance of acceleration measures and over additional costs incurred as a consequence of acceleration.

It is clear that acceleration is the source of many construction disputes. Research by Hewitt (1991)[1] noted six main causes of claims as being: change of scope, changed conditions, delay,

[1] Winning construction disputes - Strategic planning for major litigation, 1991, Ernst and Young

disruption, acceleration and termination. A survey in Canada by Semple et al (1994)[2] found four common causes of claims: acceleration; restricted access; weather/cold; and increase in scope. In a sample of 91 projects in which claims were made in Hong Kong, Kumaraswamy (1998) noted that 15% of cost claims were in respect of acceleration. Such claims were found to be of high value.

Questions inevitably arise in the evaluation of claims as why acceleration was ever proposed, which party made the proposal to accelerate, why they did do so, or for what purpose. Questions have been seen to arise as to whether acceleration measures were implemented to secure timely completion of the project or merely as convenient means by which the contractor could secure greater income from the project.[3] Other questions typically arising in the evaluation of contractors' claims for sums said to be due to accelerative measures included: whether steps were in fact taken to accelerate by the contractor and/or by others; and whether the introduction of acceleration was tackled systematically by the project's participants. More often than not, the impression emerged that acceleration had been introduced in the hope that it might 'make a difference' to the rate of the project's progress or at least to provide evidence of attempts to progress work expeditiously. Apparently little consideration appeared to have been given to how its objectives might have been achieved. An interest in gaining a better understanding of the issues raised by these questions, and many more, given the frequency with which 'acceleration' is encountered in construction projects today, were the driving forces behind this study.

Acceleration as an issue on projects is potentially of interest to many disciplines. Implementation of acceleration is of interest to the construction manager or those managing construction operations, to construction professionals charged with contract administration and to the employer. Evaluation of contractor's claims arising out of acceleration widens the sphere of disciplines to quantity surveying, programme management and law, and potentially accounting and forensic audit. From the construction perspective, the difficulties of managing a project where acceleration is required or requested are immense. The problems are logistical, practical, managerial, contractual and even psychological.

---

[2] Semple, C, Hartman, F.T. and Jergeas, G. (1994) "Construction Claims and Disputes: causes and cost/time overruns" Journal of Construction Engineering and Management, ASCE, 120, 4, 785-795.

The lawyer also will face problems dealing with acceleration. He will be faced with the dual problems of translating and recording the wishes of the businessman into a form that can be relied upon, and of doing that exercise either when drafting construction contracts or within the context of and directly in relation to ongoing contractual performance. Lawyers may also be interested in drafting suitable provisions initially in construction contracts to provide for potential difficulties consequent upon acceleration, and may also be involved in resolving disputes between parties well after the project is completed. Accordingly, the approach adopted in this thesis is to study acceleration from three perspectives, that of construction manager, construction economist and lawyer.

The body of knowledge in the fields of construction management, construction economics or law in UK contains little reference to acceleration.[4] This is surprising, as reference to acceleration, whether by design team, owner or contractor at some stage during the project, is today by no means unusual. On projects that fall into delay, reference to acceleration is becoming more commonplace. The dearth of research or written material in this area may have more to do with the recent developments in the field of project management. As will be seen later, it is comparatively recently that work of the scientific schools of management has driven the development of project management as a discipline and allowed project management as a separate discipline to flourish. This may be because the study of project management itself is not nearly as advanced as many other disciplines and due to the comparatively recent development and use of low cost, computer-based project planning (Morris (1994), Walker (1996)). Although a great deal is written on project planning techniques, little is available on the nature of progress in construction. Virtually no material on instructing or implementing acceleration, in texts on project management, contract management, administration or law, from the practical perspective of the owner, employer or engineer, is available. Consequently much of what follows regarding the nature of projects and project progress in Chapters II and III is tackled from first principles. The dearth of material in the fields of construction management, for example, means that apparently simple questions are not easily answered by reference to authoritative texts. A key reason for this study was to explore and draw together thinking in these fields.

---

[3] The reason for contractors taking 'acceleration measures' might have had more to do with a contractor's interest in reduction of financial risk, or securing profit, than timely completion.

[4] See Hudson, Keating, Pickavance and Tweeddale.

Another motivation in embarking on this study was to test certain common perceptions held by construction professionals. One was that acceleration involved working longer hours, bringing more labour on site and working at weekends. Similarly, the commonly held view that earlier completion can be achieved by deploying more resources onto a construction site was so broad as to invite analysis. This study addresses these matters.

So far as the law is concerned, little material has been published in UK directly on acceleration. This may be because it was apparently not until 1989 that the consequences of an agreement to accelerate fell for consideration before the English Courts.[5] There is, however, much material on disruption to progress, delays, construction contracts and their management available and there has been considerable judicial acknowledgement and consideration of acceleration in other jurisdictions, particularly in the U.S.

Research revealed that the body of knowledge in respect of acceleration in the US is wider than in UK. Use of acceleration on projects has a greater history in the US. Limited material is available in texts on construction management on implementation of acceleration and there exists in US a considerable body of law directly related to acceleration on projects. References to acceleration in the context of US construction law highlight particular differences from English law. The dearth of material published in construction management, construction economics and construction law with respect to acceleration was another driving force in undertaking this study.

In summary, three matters provided the impetus to continue with this study: a curious quest to learn more of the topic; drawing together material already published; and interest in developing some ideas in the field, even if it required doing so from scratch.

In the absence of identifiable sources of material on acceleration, differing opinions, ideas and philosophies are occasionally voiced. With respect to acceleration there is little common terminology, widely differing understandings as to what acceleration is or might mean, and there are different views as to how accelerative actions might be introduced, what they may entail, or how they might be policed. This study is largely directed at promoting a greater

[5] *Williams* v. *Roffey Bros. and Nichols (Contractors) Ltd* [1991] 1 QB 1; [1990] 2 WLR 1153, *John Barker v. London Portman Hotels Ltd (1996) 83 BLR 31, Ascon Contracting Ltd v. Alfred McAlpine Contracting Isle of Man Ltd (1999) 66 Con. L.R. 119 TCC*

understanding not only of acceleration itself but also of the context and circumstances within which acceleration might be expected to arise.

The purpose of this study is to explore the nature and role of acceleration within the context of construction projects and seek answers to certain questions:

- What 'acceleration' is and what does it involve?
- How might acceleration be implemented to good effect?
- What is the relationship between acceleration and other time related provisions of construction contracts?
- What are the consequences of acceleration?
- How relevant is the development of the doctrine of constructive acceleration under US law to common law jurisdictions?

B. What is meant by 'Acceleration'?

The word 'accelerate' stems from the Latin *celer*, meaning swift, which became *celerāre*, to hasten and with the addition of *ad-* (intensive) in the 16th Century *accelerāre* to go faster, then *accelerātus*. According to the Collins English Dictionary it means:

> "*vb.* **1.** to go, occur or cause to go or occur more quickly; speed up. **2.** *(tr.)* to cause to happen sooner than expected. **3.** *(tr.)* To increase the velocity of (a body, reaction, etc.); cause acceleration."

Acceleration is referred to as being:

> "*n.* **1.** the act of accelerating or the state of being accelerated. **2.** the rate of increase of speed or the rate of change of velocity. Symbol a"

Scientists refer to acceleration , represented by the symbol *a*, as being a *continuous* [emphasis added] increase of speed or rate of change of velocity. Both the common man and scientist would say that a car starting from a full stop would accelerate until it reached 60mph, but when cruising at 60mph would no longer be accelerating. Slowing down would be deceleration.

The expression 'acceleration' within the construction industry has a meaning which is, in part, peculiar to that industry and differs depending on contexts and the party using the expression.

Construction professionals in UK tend to use the term 'acceleration' to describe work which is carried out, deliberately, at pace that is faster than planned. This differs from the scientific definition in two respects. First, a contractor is understood to be accelerating not just during the time when he takes steps to increase his output but also for so long as he continues to work at the higher rate of output. Where, for example, a contractor plans to erect a brick wall at the rate of $2m^2$/hour, and increases this rate to $3m^2$/hour, it is commonly understood within the UK construction industry that the contractor is 'accelerating'. Strictly speaking, the use of the term 'acceleration' to describe progress thereafter at the higher rate is erroneous, for the scientist would only refer to the *increase* in the rate of progress from two to three square metres per hour as 'acceleration'. Notwithstanding this misnomer, this commonly understood meaning of acceleration, although at odds with the scientific meaning, is maintained throughout this thesis.[6] Second, use of the term tends to be restricted to *deliberate* increase in pace.[7] Under this wide interpretation 'acceleration' might be said to be a state in which a higher rate of progress or output is achieved in response to a request for the rate of progress to be increased or in response to a desire for the project to be completed earlier than planned.

Lawyers, contractors and project professionals interpret the word 'acceleration' differently. To contractors acceleration is understood as describing any situation in which a contractor makes a positive effort to increase the rate of progress currently being achieved. Thus, where progress during a project was behind schedule and the contractor had the choice between increasing rates of progress to maintain the completion date or simply let the end date slip, and he chooses to increase progress rates, this in the minds of some would amount to acceleration. The Chartered Institute of Building (1988) suggest that acceleration might arise either from the contractor's own mismanagement which causes delay, by invitation from the

[6] This should be unobjectionable as similar problems occur in other fields: the radiator found in a domestic central heating system is, in fact, a convector, but the misnomer survives

[7] *cf* a fortuitous increase

employer or by instruction. In each case it is said that the result is the same: work has to be compressed into a shorter period of time and thus the pace of work has to be increased to finish within a shorter period. Thus, it is not implicit within their definition that the party accelerating might be entitled to recover from the employer additional costs incurred as a consequence of accelerating.

As if to compound definitional difficulties, it is worth noting differences in terminology within the contracting community between UK and the US construction professionals with respect to acceleration. Textbooks published in US on construction management often describe acceleration as "crashing the schedule", "crashing" or "schedule compression". These terms derive from the extensive body of knowledge and the common usage of construction schedules or programmes in the US and all are synonymous with acceleration.

Construction lawyers typically adopt a much narrower view of 'acceleration' compared to contractors. Their view of 'acceleration' differs from the view of contractors in two respects. Typically, the term 'acceleration' is only taken to mean positive action by a contractor consequent upon a request from the employer. Thus, the lawyer will tend to only use the term 'acceleration' where it is understood that the contractor will be entitled to receive additional sums as a consequence of an instruction to accelerate. Second, the lawyer will tend to refer only to acceleration where it leads to achievement of a specific result, such as a particular completion date. An instruction to accelerate might be worded in resultant terms, rather than referring at all to increases in progress. For some lawyers and construction professionals at least, the term acceleration does not apply to a situation where the project has fallen into delay and attempts are being made by the contractor at his own initiative to recover lost time. This narrower view reflects a commonly adopted contractual perspective.[8]

Pickavance (2000), a chartered architect with legal qualifications, suggests two definitions of acceleration, the first as "the completion of work in a shorter time than that anticipated in the light of the resources planned, in the degree, disposition and under the circumstances anticipated by the contract documents".[9] He adds that acceleration is usually achieved by the

[8] See for example in UK under the General Conditions of Contract for Building and Civil Engineering (GC/Works/1 Edition 3)

[9] 2nd Edition, page 73

adoption of increased working hours, overtime and double/triple day shifts or by logic changes which compress the work sequences. The author's second definition[10] is as follows: "Progress greater than [the contractor] expected to make with the degree of productivity allowed for and upon which [the contractor's] tender was based." It is suggested that neither definition is satisfactory. Whilst the two definitions reflect the differing views on acceleration (construction professionals regarding acceleration as a heightened state of activity and lawyers understanding acceleration in resultant terms), it is suggested that 'the completion of work in a shorter time than that anticipated' or 'progress greater than expected' might be achieved by good fortune, or by judicious planning and management of the project. Were this to occur, it would be a matter for the contractor: he would have no answer to the employer's claim that it was for the contractor to plan the work as he saw fit and ought to be thanked for timely performance.

Again a distinction must be made between interpretation in UK and US. North American texts on construction law or construction claims tend to refer to acceleration with some precision, reflecting the body of law already established in the US and Canada. In *Morrison-Knudsen Company v. British Columbia Hydro & Power Authority,*[11] a Canadian decision, Macdonald, J. defined "acceleration" in the construction context as follows:

> "By acceleration I mean speeding up the work - increasing the rate of performance of the work - in order to overcome delays and complete by the dates specified in the contract work which has fallen behind schedule. Acceleration may be undertaken in order to finish by the contract dates work which has fallen behind schedule due to: (1) delays for which the contractor is solely responsible; (2) delays attributable entirely to the owner; and (3) delays which are a combination of the two, that is, delays for which both contractor and owner are responsible." [12]

In *W.A. Stevenson Construction (Western) Ltd. v. Metro Canada Ltd.*[13] Locke, J., as he then was, referred to the concept of acceleration as follows:

---

[10] 1st Edition, page 349

[11] (December 6, 1974) S.C.B.C. Action No. 2572/67 (Vancouver Registry) (B.C.S.C.), and cited in Golden Hill Ventures

[12] *ibid*, at Part 11, pp. 2-4

[13] (1987), 27 C.L.R. 113 (B.C.S.C.),

> "Throughout this job the contractor was told he had to meet the milestone dates in the contract. Conditions of work which delayed the execution of the contract were forced on it by the owner (e.g. non-removal of buildings). Weather conditions plainly impaired the ability to perform. If the owner insisted on performance by the contract date, the slowed work had to be made up with extra resources of capital and labour. This compression in time is one definition of acceleration. Like the Red Queen, the contract had to run faster just to stay where it was in relation to the time frame of the contract."

These descriptions might usefully be compared with the comments of Hicks J in *Ascon Contracting Ltd v. Alfred McAlpine Construction Isle of Man Ltd:*[14]

> "Acceleration tends to be bandied about as if it were a term of art with a precise technical meaning, but I have found nothing to persuade me that that is the case. The root concept behind the metaphor is no doubt that of increasing speed and therefore, in the context of a construction contract, of finishing earlier …"[15]

In US publications, a distinction is generally made between *directed acceleration* and *constructive acceleration*. This distinction appears to be universally acknowledged by construction lawyers in the US. Mitchell (1977) defined acceleration as "an order, either actual or constructive, requiring a contractor to complete performance earlier than a currently adjusted-progress schedule and contract completion date would otherwise require" and draws the distinction between directed and constructive acceleration. Directed Acceleration, he says, occurs when the employer or his agent expressly and specifically orders a contractor to accelerate. Constructive Acceleration, he says, occurs when a the employer/employer's agent refuses to timely grant time extensions for excusable delays and requires a contractor to perform according to an original contract completion date without regard to time extensions due. Such a refusal, he says, means that that contractor has less time to perform than originally provided in the contract and, thus, must accelerate.[16] Similarly, the US Army Corps of Engineers (1987) defines directed and construction acceleration as follows:

> Acceleration (Directed): The buying back of a time extension due to the contractor under the terms of the contract in an effort to complete the work within the existing contract completion date.
>
> Acceleration (Constructive): An act or failure to act by the Government which does not recognise that the contractor has encountered excusable delay for

[14] 66 ConLR 119

[15] *ibid* at 136.

[16] This definition is adopted by Battikha (1996)

> which he is entitled to a time extension and which requires the contractor to accelerate his schedule in order to complete the contract requirements by the existing contract completion date. This situation may be brought about by the Government's untimely denial of a valid request for a contract time extension or by the Government's untimely granting of a time extension.

Constructive acceleration is founded upon a doctrine developed to overcome difficulties particular to US Federal Law and the Board of Contract Appeals, a government agency. The relevance of this doctrine and developments by the US federal courts will be explored later. Nevertheless, use of the term 'constructive acceleration' is occasionally to be found in the UK, reflecting the American influence. Despite arguments that the doctrine of constructive acceleration has no place under English law, the growing use in UK of claims founded on constructive acceleration means that it must have a place within this study.

Bramble and Callaghan's definition (1987) was that acceleration occurs when the owner requires the contractor to complete construction as originally scheduled rather than within the extended time the contractor was entitled to as a result of excusable delays. This is deficient in two respects. It refers to neither a shortening of the contract period or constructive acceleration. Callaghan (1991) says that acceleration is doing something faster than originally anticipated. He observes that it occurs in two forms. The first is when a contractor is required to accomplish the originally anticipated work within an intentionally shorter period, and the second is where a contractor is required to accomplish increased, additional or delayed work within the original time period, that is without the benefit of a time extension. Callaghan's 1991 suggestion is an improvement on Bramble and Callaghan's definition as it successfully deals with both directed and constructive acceleration.

So far as a suitable definition for the UK is concerned, it is submitted that acceleration, whether expressed in resultant or activity form, comes about in response to matters either external to the project,[17] or internal to the project,[18] and which comes about at the instigation of one party as a reaction to a perceived or actual difficulty. Each construction or engineering project is a unique undertaking. Unlike the production line assembling a component continuously, a project has a finite start and, by its very nature, a defined completion. The question of the rate of progress achieved during the course of a project is, on one view,

[17] Such as a request for an earlier completion date.

irrelevant so long as the project is finished on time. But the more usual position is that one or more of the parties involved with the project, whether employer, contractor or otherwise, will have some economic interest in the project being completed by a particular date, either due to a contractual obligation or simply because the employer wishes to put the facility to use. The very existence of the risk that the project will not be completed by the planned completion date is usually enough to promote interest by project participants in the rate of progress being achieved. During the course of projects there may be a realisation by one of the participants that the current or future rate of progress being achieved is insufficient and will not be sufficient to secure completion by the planned date or time, or that the project needs to be completed earlier. Some response may be required to remedy this situation. Alternatively, the owner may simply want or need the facility earlier than previously thought, and sees that some action needs to be initiated to facilitate this. Thus, it is suggested that acceleration is:

> *a positive response, by a project participant, directed at improving the rate of progress above that which otherwise would have been achieved with the aim of either securing earlier completion or to reduce the risk of timely completion not being achieved.*

In summary, a particular difficulty is that inconsistent understandings and definitions of acceleration have emerged with differing views between construction management professionals and construction lawyers. A further difficulty is that differing understandings have developed in different countries. Thus, there appears to be no universal definition as to what the expression 'acceleration', when used in the context of construction projects represents.

Care needs to be taken with definitions as to what is meant by acceleration, with much depending on the profession and nationality of those using the term. It is appropriate to distinguish, as is common in US, directed and constructive acceleration. For the avoidance of doubt, in the sections of this thesis dealing directly with construction and project management, acceleration will be used within the wider sense noted above. Within its legal context, care will be taken to define acceleration at each stage according to the relevant circumstances to avoid definitional confusion.

---

[18] Such as a delay that needs to be recovered.

C. Historical Development of Acceleration in Projects

Regrettably, no research appears to have been conducted to assess the incidence of acceleration on construction projects in UK. Acceleration in some form has apparently been undertaken in the past. Projects had been speeded up at their end, sometimes by agreement and arrangements to work 'special measures' have been known to occur.[19] The use of the term 'acceleration' seems to have been first used in UK from early 1980's. From anecdotal evidence and experiences of construction professionals involved with resolution of construction disputes, it seems that, for several reasons, specific use of the term acceleration on projects before 1980 was comparatively rare. Since then, four factors appear, together, to have promoted the use of acceleration on projects as a tool to secure timely completion: changes in computer technology make planning easier, the time and expense required and consumed in pursuing claims and the growing insistence of employers to secure timely completion.

(a) Technological changes.

Planning software had been available since the 1960's when CPM techniques were developed, but at that time suffered numerous difficulties. Computer usage was expensive, complex, and slow and had to be carried out through specialists. The simple process of updating a programme to show progress took days; consequently scant regard was paid to computer based planning. Contractors had enough difficulty achieving satisfactory progress without having to contemplate moves to improve the rate of performance midway though a project and for that improvement to be planned and measured.

It was not until the mid-1980's that the use of computer based planning and scheduling software became commonplace, as the cost of personal computers dropped, software became more user-friendly. Planners were able to update programmes quickly to reflect progress, reflect the project's complexity through the planning software using critical path analysis and, more importantly, publish the results of their work frequently and in a variety of forms. The fall in the cost of personal computers in the mid-1980's allowed use of planning software to

[19] See for example Sir Lindsay Parkinson & Co. Ltd v. Commissioners of H.M. Works and Public Buildings (1949) 2 KB 632 for a rare example in law reports of a contractor accelerating to recover delays pursuant to a supplemental agreement whereby the contractor was to adopt a revised uneconomic method to complete the works.

become widespread throughout the construction industry. It is also apparent that from the early 1980's construction professionals were gaining greater familiarity with construction planning techniques, thus encouraging questions to be asked of contractors as to whether rates of progress might be adjusted and how this might be achieved. (Walker, 1996, Morris, 1994) The significance of the these changes was that, for the first time, sophisticated planning and scheduling software allowed alternative construction sequences, assumptions and predictions to be tested and re-tested in a matter of minutes and at minimal cost. This allowed contractors to explore, in outline at least, whether the time required for completion of work might be shortened.

(b) Difficulties pursuing claims.

With a project in delay, contractors were faced with the dilemma of pursuing a claim for an extension of time and financial recompense in order that the project might not be loss making. The difficulty with pursuit of such a claim was both in the time and expense required to secure a result and the inherent uncertainty in the result that might be achieved. Settlement through negotiation appeared to bring just as many uncertainties as pursuing claims through arbitration or litigation. For contractors, the prospect of an immediate settlement of the delay claim by an agreement to accelerate performance to recover delays, for further agreed consideration, can have the real attractions of certainty and prompt payment.

(c) Client demands.

Developments in corporate management in the last 10 years have placed greater emphasis on efficiency, achievement, and constant improvement. Major corporate groups have, in short, become more demanding. Whereas in the past they had no choice but to listen to their contractors say that the project was in delay, the trend today is for insistence upon timely performance, particularly where the consequences for the business of late completion far outweigh modest increases in construction cost through payments for acceleration. The price buys a lower risk of delay to completion. In parallel with this, greater use is now made of contractual structures, particularly construction management, which provides to the employer greater control over works contractor's contracts and targets.

(d) The rise in the use of subcontractors.

Greater use of subcontractors (compared to a direct labour force) has increased the extent to which contractors can direct and change priority areas of work and increases more control over the dates by which particular areas of work are done. The typical contractor, before instructing a subcontractor to undertake work in a varied sequence will seek prior agreement with the employer that such a course of action is one for which he might be reimbursed additional costs incurred. Questions as to whether certain areas of work are to be accelerated are therefore more frequent.

The alternative hypothesis, which remains difficult to test in the absence of detailed accounts of project progress and performance, is that before 1970's contractors did, on occasions accelerate or alter sequences of work to accommodate the employer's wishes. By all accounts, on such occasions the additional cost of varied performance did not become a matter seriously in issue between the parties. If anything, it was not until 1980's that employers or construction professionals came to expect contractors to accelerate and only then that contractors became more confident in making acceleration based claims.

Today many standard forms of contract do not yet contain provisions with respect to acceleration. If they do, introduction of those provisions was within the last 10 years. It is only in the last four years that standard supplementary agreements, for use during projects, were published.

D. Matters with which this study is concerned

This thesis is concerned with the study of acceleration in the context of construction and engineering projects. As it is ordinarily understood, acceleration is simple to understand. It simply means speeding up, or progressing something at a faster rate than before. A single geared bicycle accelerates by pressing harder on the pedeals. A car accelerates by depressing a floor pedal, which in turn increases the follow of fuel to the carburetor. But can a construction project be accelerated by adding more labour? How are construction activities, and entire projects accelerated? Hence, Chapters II and III review these questions from a construction management perspective. Much of the work in these sections has been undertaken from first principles, using a deconstruct-reconstruct methodology. By a conceptual analysis of project processes, an attempt is made to determine how it is that projects, including activities which are part of the project, progress at all and to establish what conditions are necessary for any progress to be made. Once it is clear how projects progress, the next chapter considers how the rate of progress might be increased, or accelerated. The resulting conceptual hypothesis is then tested against literature on construction management and accounts of accelerated projects. These sections lay the foundation for later sections, particularly those concerned with the consequences of acceleration and analysis as to how the parties' economic interests are affected.

The next three chapters deal with commercial aspects of acceleration. Chapter IV deals with the range of costs potentially arising from acceleration. Chapters V and VI are concerned with implementation of acceleration. They review the decision making process on projects with respect to two questions not infrequently asked on projects: whether acceleration should be introduced, and if so, how might it be introduced? Detailed consideration is given to the use of programmes and project planning as part of implementation considerations. Issues such as the information, documents or strategies needed for acceleration are addressed. The methodology used is to analyse literature and to review issues arising from case studies. This raises further questions as to whether acceleration is or might be avoidable or whether the risk of acceleration can be reduced. Thus, this section is essentially concerned with the acceleration as part of, using Morris' words, 'the management of projects'.

The second main area of research is a study of the consequences at law of acceleration. Chapters VII, VIII and IX are concerned with how the economic interests of the contracting parties are protected when acceleration is introduced, particularly under the English and US legal systems. Projects are managed within the framework of contractual powers and obligations. On construction and engineering projects that framework is complex, partly designed to reflect the parties requirements and to safeguard certain interests. This framework, particularly the management of time-related matters within the contractual framework is critically reviewed to address the position of acceleration within that framework. The methodology used includes analysis and consideration of standard forms, judgments from UK, commonwealth and US as appropriate, legal principles and policies in light of (a) earlier chapters and (b) acceleration in practice.

Chapter X deals specifically with specific quantum issues following from work in earlier chapters on the potential bases of recovery, and deals with mitigation, quantum meruit and restitution issues.

Finally Chapters XI and XII deal with hypotheses, their treatement, a summary, conclusions and recommendations for further work.

Throughout this work hypotheses are tested by a review of literature, analysis of Case Studies and working from first principles. The Case Studies are set out in Appendix A. Save for one project[20], these are real projects with which the author was directly involved; the information set out has been gathered first hand. A summary table at the front of the Appendix shows that the cases chosen span main contractor, and subcontractor contracts, and cover buildings, infrastructure and other projects.

This study shows originality in several ways: First it aims to draw together into one place matters relating to acceleration from several perspectives: construction management, construction economics and law. Second, an attempt is made to draw on each competing perspective in bring together the summary and quantum chapters. Third, case studies are used to depict some typical scenarios and provide a factual basis for assertions, and as a research base. These are importance as the incidence of reported judgments in UK is very low.

[20] The Island Crossing case study details were provided by my Supervisor, John Barber. They relate to a pro-forma acceleration agreement published in a book on construction claims.

II. Causes and characteristics of acceleration

Three matters are dealt with in this chapter. First, by analysis of a car journey, explanations are sought as to (a) what possible motivation there might be for accelerating a project and (b) from where the impetus to accelerate might arise. Second, a brief review is undertaken to understand what conditions are required for acceleration to occur, and third, characteristics of acceleration are assessed. Little, if any, consideration has been given to these issues within leading journals, Hence, much of the argument is developed here from a first principles methodology.

A. Why accelerate anyway?

According to Morris (1994), the management of projects is "the management of the process of establishing the project's objectives and its definition; of assessing it so that it is set up with the maximum chance of being successful technically, commercially, socially, etc. for all the parties ('stakeholders') it affects; and of accomplishing it efficiently and effectively". This, at least, suggests that the overall aim of acceleration is to help the project meet its objectives and accomplish completion of the project efficiently and effectively.

It is not difficult to see that acceleration may be a necessary part of the management of a project. Acceleration may be required in order, using Morris's words, to accomplish the project efficiently and effectively. Thus, acceleration .might usefully be regarded as a management tool or technique that might be deployed as appropriate. If managing a project involves, using Morris' words, assessing it so that it is set up with the maximum chance of being successful, the project will need to be set up so that the risk of the project being unsuccessful (of which late completion is a part) is minimised. If acceleration is needed during the project's execution, its implementation may, therefore, be indicative of an earlier failure on the part of one of the project's participants charged with managing the project.

Hence, accelerating progress might be indicative of an earlier failing or may be an attempt to save a project from a disastrous outcome. If acceleration potentially has an adverse affect on project economics it is hardly acceptable to say that acceleration is undertaken for the benefit of the project. Hence the management of projects, particularly at the later stages can involve some complex decision taking and action in response to unplanned events. The question as to why acceleration might be implemented has received scant treatment by authors and commentators, whether in the fields of construction management, economics or law. Hence, the analysis set out below is largely derived from first principles and, to an extent, tested against some known projects where acceleration was implemented.[21]

The example of a car journey

In order to understand the underlying reasons why accelerative action is taken on projects, and some likely consequences, it is instructive to analyse acceleration in the more familiar context of a car journey. Analysis of a car driver's decisions and actions taken on a long journey is instructive in understanding the motivation for a change of pace by the driver during the journey.

Some similarities between a car journey and a construction project are immediatlely obvious. Both have finite starts and finishes. In both, parties can be expected to have some interest in timely completion. Both progress in real time and are affected by the vagaries of the environment in which they progress. The rate of progress of a construction project, like the car journey, will deviate from the rate of planned progress, changing by the hour and by the day, due to the variety of day to day difficulties such as poor weather, staff sickness, late deliveries, etc.

There are, of course, some differences between the car journey and construction contracts. There is a broadly direct relationship between the volume of petrol which enters the engine and speed achieved, whereas the relationship between resources and progress on construction projects is indirect, because much depends on how various resources (plant, labour materials, management expertise, information and space) are mixed. The performance of a car relies upon petrol or gas; a project relies upon the performance of personnel and subcontractors. Another difference is that the owner is not, ordinarily, in a position where he pays on completion, as he or his agents (architect, engineer, or surveyor) contribute resources essential to performance. The assumption used nevertheless is that the employer or his agents do not ordinarily interfere so as to delay contractors. These differences, it is suggested, do not reduce the appropriateness of the car journey as a performance model with respect to motivation for acceleration.

[21] See Appendix A

For the purposes of this analysis it is assumed that the driver is intent on reaching his destination by a particular time. Obviously the accelerator pedal is used to increase speed at the start and during progress of the journey. Otherwise, the rational choice would be to drive at constant speed, economising on fuel and driving effort. Changes in speed require some positive action.

Rather than driving at constant speed, the car will slow down and speed up to overcome a local or temporary difficulty. The local difficulty hardly needs elaboration. The driver faces traffic lights, roundabouts, traffic in towns, slow drivers, poor weather, hills, slopes and the need for a break from time to time. Local difficulties, one would commonly say, are a natural part of the journey. The driver's constant adjustment of speed is undertaken in order that his own comfort and safety are maximised. If he drives too fast, he may crash or be arrested; if he drives too slowly, he will arrive late at his destination. When the driver sets out he ought to anticipate these sorts of difficulties, and in calculating the amount of time it will take to reach his destination, he generally ought to take into account the local conditions that he ordinarily expects to encounter on a journey to the particular destination at the time he is to depart. Thus, he ought to allow more time for travel during the peak rush-hour than at off-peak hours, or more time for driving through a mountainous route than travel of the same distance along a motorway. At any stage of the journey, one might observe that the progress achieved was broadly in accordance with the overall plan, and that the remainder of the trip will probably be achieved in the time allowed.

Of more significance in this study is a change of pace that goes beyond that anticipated or required to get to the destination on time. There seem to be two reasons why the driver might depart from the planned rate of progress.

- Since setting out on his journey some external impetus leads the driver to change pace in order to arrive at the destination earlier than planned;[22] or

- Since setting out on his journey he has been unexpectedly delayed on route by some difficulty for which no allowance was made which will result in his late arrival at his

[22] For example, the driver may be advised by mobile phone that the meeting his is to attend is to commence early, or he hears of a demonstration due to take place that morning in the city centre so tries to arrive early to avoid the likely disruption to traffic

destination. To avoid arriving late, he chooses to accelerate in order to overcome a significant delay.

There would seem to be three reasons why the driver on a journey might accelerate; (a) to start the journey or to overcome a local difficulty; (b) to attempt to complete the journey earlier than planned; and (c) to attempt to reach the target destination on time notwithstanding delays. Whatever the motivation, a change is likely to result in a move away from the preferred travel speed, affecting fuel economy, and requiring some intervention on the driver's part.

The conditions necessary for such a change of pace to be achieved are considered below, first by analysis of the extended analogy of the car journey, and second that analysis is extended to construction projects.

Application to construction projects

It would appear, prima facie, that the reasons for accelerating progress of a construction contract ought to be similar to those of a car journey. Thus, accelerative measures will be taken either as part of the normal vagaries of the project would ordinarily require; or as a response to a need to complete before the contract completion date; or to maintain progress at a satisfactory rate following delays or matters arising which would have delayed completion. The latter two categories are the most significant. That distinction is used throughout this study.

A car will speed up to overtake, slow down as it turns the corner onto the slip road, and then speed up again as it leaves the side road and enters the motorway. Is it likewise with the pace of construction work on a project? In theory, one might expect that more plasterers will be brought to the site when there are more rooms to be plastered, and plasterers withdrawn if the plastering labour force is idle whilst they await the progress of others. In fact when reviewed in detail, projects may lack the flexibility of supply of resources. There are many explanations for this, (these are explored later in some detail), the most notable of which is economic constraints. It is well known that one team working continuously on a project for months are more likely to proceed economically than crews that grow and shrink in size depending upon work available. Thus, changes of pace of a subcontractor's work may be required in order to allow other more significant work to proceed, in a bid to move away from the subcontractor proceeding at a steady pace. To the subcontractor, this may seem like 'acceleration'. To the employer, it may seem that the project is taking its natural course.

It will suffice to note that what may seem to one party to be a request for acceleration, in the sense that work is to proceed at a pace, for part of the work, that is different from that expected, another party may view this as a normal part of a project's progress. It is perhaps for this reason that contractors tend to refer to any deviation from planned performance as amounting to acceleration whereas lawyers are more inclined to restrict use of the term acceleration for a change to the date for project completion. Projects differ, therefore, as the question whether there has or has not been acceleration may depend upon the perspective taken.

Why do employers bring forward the contract completion date?

Instances of employers bringing forward a date for completion are comparatively rare: none were found in the case studies used in research[23] nor are any evident from disputes before the UK courts. If a project is proceeding to plan, there is no apparently obvious reason why any party would want to accelerate the planned rate of progress so as to achieve completion by an earlier than planned date for completion. Conceptually, like the car journey, it would appear that there are three matters that might each cause the date for completion to be brought forward:

(1) The correction of an error. Some matter has arisen since contract commencement that forces reappraisal of the completion date required. An apparent cause of reappraisal arises during evaluation of the transfer from project to occupational phase: this tends to expose that contracts may seek to declare completion with the work substantially completion albeit with isolated or defective matters to be corrected, whereas a functional unit requires trained staff working in a facility capable of being used without interruption.

(2) The desire to reduce risk with respect to completion. These include insurable risks arising from matters outside the project environments and may include non-insurable business risks. For example, an employer may choose, for a project to be completed by 1 January 2005, for

[23] The case studies are set out in Appendix A.

the facility to be completed by late November 2004.[24] Although the facility may sit empty or under-utilised for a month or so, the cost of early completion may save embarrassment, negative publicity or loss of business due to late entry to a competitive market consequent upon late completion. What drives a push for early completion is the apparent need to avoid, at all costs, late completion of the facility.

(3) An external stimulus imposed mid-project which causes a reappraisal of the target date for completion.

In practice two constraints are apparent that will limit project-wide acceleration. First, the contractor may advise that completion by a foreshortened date is simply not possible. Early completion of part only may have to be considered instead. What is evident, however, is that employers have sought to bring *part* of the works forward. This is presumably a means of accommodating whatever earlier completion was possible without radical changes to the scope of design of the works.[25] Secondly, even if it is possible to bring forward the date for completion, doing so may require omitting some work, or requires a change in the way the works is to be carried out that is disproportionately costly to the value to be achieved. The increase in the price may have to reflect not only the direct additional cost but also the increased risk of non-completion against the accelerated date. Put shortly, (whether or not the parties acknowledge or realise these limitations before acceleration commences), acceleration might be limited by what is physically possible or economically sound. Acknowledgement of these limitations can, it would appear, help to shape the extent to which acceleration is sought.

In summary, an employer can be expected to bring forward a completion date, shortening the contract period, where economically viable, to (a) correct errors in the original estimated date, (b) reflect business needs which have become apparent since commencement, or (c) reduce risks of late completion by providing a greater margin for error.

[24] The International Olympic Committee now requires of each prospective host country that facilities are to be completed by Spring of the year in which the Summer games are to be held. It apparently introduced this requirement after the last minute frenzy required to complete facilities for the Summer Games in Montreal in 1976 and in the light of costs incurred in securing last-minute completion.

[25] A known example is the Leuna project (Case studies, Appendix A) where, the sequence in which units were to be completed was changed in order to bring forward the date for completion of some parts, as a result of revised subsidy-driven business case which made this necessary to secure a subsidy.

Why might acceleration be introduced to recover delays?

'Recovery measures' are often instigated by the employer to enable the project to recover from delays. But why are they introduced? From the car journey example it was noted that the rate of progress was accelerated where the car was progressing slower than planned, and the driver preferred timely, instead of late completion. Thus, several elements are necessary: the delay; realisation that there is a delay; and a conscious decision to achieve completion earlier than might be the case in view of delays recently suffered. But this does not provide a complete explanation as to why projects are accelerated: a very high proportion of construction and engineering projects incur delays, but few are accelerated. Thus, some refinement in decision making on the part of employers is evident before any acceleration is sought. Some aspects of projects in which acceleration has been ordered thus require review in order to understand this apparent refinement.

Completion requirements

It is apparent that employers having varying levels of interest in securing prompt completion. Completion requirements appear to fall into three broad categories:

(a) he prefers to finish on time to avoid exposure to risks, costs or embarrassment that might be incurred if completion is late.

(b) a delay can be entertained, but the employer is prepared to pay significant sums to the contractor to secure the contractual completion date, provided the costs are not so high as to be hugely disproportional to the benefit of timely completion. Such a decision is, or ought to be, driven by economics; and

(c) the completion date must be achieved, in that the employer simply cannot entertain late completion. This is most evident where completion of the facility under construction is required to house an event, the date for which cannot be moved. Well-documented examples include facilities required by the host nation for international sporting events or to celebrate a particular date;

It will be immediately apparent that employers can be expected to put the highest value on completion in category (c) and lowest value on prompt completion in (a). The propensity for acceleration to be introduced might be expected to follow those priorities. This is borne out in practice. Some of the best documented instances of acceleration on projects (carried out at great expense) were: for facilities required for the Olympic Games in Montreal in 1976 and Greece in 2004; and to complete the Millennium Dome in Greenwich, London before the night of 31 December 1999 to stage a party that night; and the race to make operational the London Underground Jubilee Line extension by 31 December 1999, in order to carry the anticipated large volume of visitors to the Dome on and immediately after that date. It is also apparent from the case studies.[26]

Project economics

It is apparent from case studies that employers' decisions to accelerate are largely made on the basis of, or after some consideration of, the perceived cost impact to the project. Put simply, it appears that in view of the high cost of employers of their projects, some judgement has to be made as to whether acceleration would leave them better off financially: it is a value judgement.

Value evaluation in the case of acceleration is comparatively complex. It involves balancing several elements:

- the perceived cost of accelerating, being the sums payable to the contractor. Rarely are these costs quantified, or volunteered by contractors, before acceleration measures are taken. From cases analysed, it appears that employers tended to under-estimate the range of likely acceleration measures to be taken and quantum of likely costs; and

- the perceived amounts that would likely be incurred if the project were not accelerated, but which might be saved through timely completion.[27] This is potentially wide

---

[26] See in Appendix A the case studies of the National Exhibition Centre, where work was accelerated to achieve completion for a fixed-date exhibition; and DeMontfort University, where completion was required to provide facilities for the start of the school year.

[27] The amount of liquidated damages set out in the construction contract should reflect the amount that might be incurred by employers where the delay is of the contractor's own making. It will not include the quantum of likely time-related costs payable to the contractor where the delay is employer generated. Hence, where acceleration is required to recover employer-generated delays, it is unlikely to act as a useful guide and will probably be too low.

ranging, and includes:

- costs payable to the contractor (time-related site establishment and overhead costs);
- penalties payable by the employer to third parties in the event of late completion;
- lost subsidies or lost profits incurred by the employer through late opening of the facility;
- loss of reputation. This is probably unquantifiable. A notable example was that the Athens Olympic Committee agreed to accelerate progress of construction to ensure facilities were completed for the 2004 games rather than having the Games transferred at short notice to an alternative venue.

The employer will save the cost of loss and expense to which he might have been put had the delaying events or matters *continued*. What of loss and/or expense already incurred by the contractor before the date of acceleration? Before any accelerative action is taken, a contractor will ordinarily incur loss and expense[28] at the time of a delay to the regular progress of the work.

Thus, before acceleration is introduced, if the project was in delay and the delay was caused by matters for which the contractor is entitled to recover loss and/or expense incurred, both time and volume related loss and expense may have been incurred for which the contractor can seek compensation. It is not, it is submitted, right to view time-related costs as those which are only incurred beyond the original completion date. Were accelerative action

[28] Loss and expense is usually characterised as falling into two categories: time-related cost and volume-related costs. The former are costs incurred as a function of time, such as site accommodation, the salaries of contractor's staff that will always be required on the project, and plant that will always be committed to the project. As well as being put to additional expense, the contractor may also incur losses as a function of time, in that an extended project duration may deprive the contractor of the opportunity to use his resources on other projects and thereby recovering a contribution to overheads and earning profits. Volume-related costs are those incurred as a function of volume. Labour, materials, mobile plant, temporary materials, and supervisors fall naturally into this category. The extent of cost incurred will depend on the volume of work carried out. Where the contractor is asked to carry out additional work, he not only incurs those costs but may also incur losses. Losses arise, for example, where the cost per unit of work is higher because it was disrupted leading to reduced productivity. Loss and expense and contractors' costs are explored later in further detail.

contemplated, it would be reasonable to expect credit to be given, as part of the cost of accelerating, for savings in time-related costs. It is most unlikely, however, that the contractor will see any reduction in volume-related losses already incurred through accelerative actions.

The cost to the employer will be the amount paid to the contractor (and amounts paid to other parties to whom he is contracted such as the design team) consequent upon the agreement made with the contractor. Accordingly, for the employer, acceleration can be of positive value where the acceleration cost to which the employer is put does not exceed business losses and the contractor's loss and expense to which the employer would have been exposed but for the accelerative measures. No saving would be made on volume-related loss and expense already incurred by the contractor.

According to the value evaluation, acceleration is only likely where the cost of accelerating is perceived to be less than the costs likely to be incurred absent any acceleration. This test seems sound. It is apparent from analysis of some well-known instances where acceleration was introduced, especially the London Underground Jubilee Line extension by 31 December 1999, where timely completion was essential to avoid paying the forfeiting subsidy of some £400m to the developers of the Canary Wharf complex in the event of late completion. It is also evident from case studies.[29]

It will also be apparent that while much of the value equation can be quantified in advance, and steps taken to limit potential exposure, it appears that some employers give little regard to or have an inadequate understanding of the elements of the equation. There are instances in case studies of employers who mistakenly believed that acceleration would be at no cost on the understanding that all delays to date were caused by matters for which the contractor was responsible;[30] that little or no delay costs have been incurred to date[31] or where decisions were

[29] See particularly in Appendix A the case study of the Leuna project, where acceleration measures were implemented as timely completion was required to secure an EU conditional grant of some Euro550m.

[30] See Case study for UK paper mills at Kemsley; or National Exhibition Centre study where the project manager was of the view that an instruction asking for "Special Measures" was merely a request for the contractor to use best endeavours to prevent delay, and thus believed apparently that no cost would be incurred as it was not a request to accelerate.

[31] See case study for King's Lynn power station work

made apparently without any evaluation of likely cost.[32]

Confidence

Instructions to contractors to accelerate, even if made with the contractor's consent, are laden with risk. Some potential risks include the risk that existing delays will not be alleviated at all (and thus costs incurred in acceleration will be wasted) or that other causes of delay may arise in any event. For acceleration to be implemented requires the employer to have some confidence that the contractor can successfully implement measures and that costs can be controlled. It is noted that, in some instances, accelerative action was taken simply because it was possible, or because the contractor advised it was possible.

So why does the employer not just leave the project to finish late? First, from the case studies, it appears that the employer must put an exceptionally high value on timely completion, so that timely rather than late completion is preferred. Second, the employer must perceive that earlier completion is possible. Consistent with the value put on completion, it is axiomatic that the employer believes, or assumes, that the cost of accelerating is fair, in that the value of accelerating exceeds the cost, however it is that cost and value might be measured.

Fear of failure

For all of the discussion of cost and value, it appears that there is one other reason why the employer may require or demand performance that recovers delay. It is simply that, in the face of ongoing work, and faced with the need to make judgements in an uncomfortably short period of time he makes the decision out of fear of failure, fear that late completion is unpalatable. The decision to accelerate is made in response to the contractor's suggestion, more out of a sense of hopelessness than based upon value judgements. In this respect, the project is not unlike the car journey where the driver's decision to speed up so as to reduce delays may be less than rational, when made in haste during the course of the journey.

Why might a contractor voluntarily accelerate?

---

[32] See case study for Sutton Bridge Power station.

The analogy of the car journey is of little assistance here: the real question is why a contractor might take accelerative action without any request from the employer to do so. On the face of it, the simple answer is that he can be expected to accelerate to recover delays. Rationally, the expectation might be that the contractor is not likely to take any accelerative measures unless (a) the employer was going to pay for it, or (b) there was no prospect of employer paying, but it was economically worthwhile. Rationally, a contractor would not be expected to undertake any accelerative action unless the value of so doing exceed the cost.

But a more detailed analysis, through the case studies, reveals a more complex position. Whilst some actions are dictated by exposure to additional cost at subcontract level, research suggests four reasons why accelerative measures might be taken.

First, where the contractor has caused delay in circumstances where it is clear, or there is a risk, that the delay will delay completion of the project, limited and targeted acceleration measures at subcontract level are likely to be instigated.[33] This is most likely where the cost of accelerating is calculated to be less than the loss that might have been incurred if the project finished late. Measures in these circumstances are likely to be introduced without the employer being advised of this. Whether the employer is advised of this acceleration is a tactical issue: some prefer to act undisclosed, in the hope that the costs of acceleration can be later claimed as a consequence of some employer-caused event.[34]

Second, where there the cause of delay is less than clear, or there is the prospect of a prolonged dispute over which party has caused delay, the contractor accelerates with a view to completing on time. The motivation for such actions appear to be mixed, involving an immediate interest in avoiding arguments over ongoing delays, but with a perceived chance that the cost of acceleration might be recovered from others. Here the employer is likely to be put on notice of the actions being taken, or perhaps even invited to approve them. This, from research, is comparatively common.[35]

Third, there is a chance, notwithstanding liability, that the employer will agree to reimburse

[33] See case study for Sutton Bridge Power station.

[34] See case study for Rugby Cement.

[35] See case studies for Kings Lynn Power station, Sutton Bridge power station, MAFF offices in London, Baris' work at Braehead shopping centre and Victory House.

the contractor additional costs to which he is put, or agrees to pay a premium, for timely completion.

Fourth, the contractor may accelerate to avoid breaking a non-contractual commitment, to save face or to maintain a reputation. The contractor may derive value in the form of goodwill where timely completion is achieved. This goodwill may be a significant factor, albeit difficult to quantify, in securing future business.[36]

What emerges here, from research, is that contractors are more likely than not to take some accelerative measures to recover delays at their own risk, but in a measured way with a view to others funding the additional measures in due course.

B. Conditions necessary for acceleration

For the car driver, acceleration is easy: application of pressure on the accelerator results in additional fuel entering the carburettor that increases speed. In fact, it may be more complex. Should the driver risk breaking a speed limit? What if he is short of fuel? Why should be bother speeding up? In order that these situations are properly analysed the analogy of a car on a long journey will be extended. Assume instead that there are two parties involved, a lorry driver and a consignee. The lorry driver is contracted by the consignee to deliver goods from Liverpool to London. The journey is some 200 miles. Assume also that the driver only gets paid upon delivery of the goods. As the goods are to be delivered by 1pm, the driver decides to set off at 9am, leaving four hours for the trip.

Completion sooner than originally planned

If, during the journey, the lorry driver is proceeding as planned without any unexpected delay, why might he decide to increase speed in the sense of going faster than he had otherwise intended other than to overcome a local difficulty? The answer can only be that he speeds up so as to reach his destination sooner than originally planned. Assuming the aim is to arrive at a particular time, (such at 1pm) and the originally time allowed was apparently adequate, the

---

36 Thus, a regional UK based contractor built a brand around the slogan "Mansell – on time". That firm was known for its reputation of achieving timely completion. It was known to have accelerated voluntarily to protect that reputation.

increase in speed would obviously only be provoked by a change to the planned arrival time, which has occurred since commencing the journey. Either the driver has changed his mind, and simply wants to arrive earlier, or some external event has occurred which provokes his interest in reaching his destination earlier. The obvious example would be of the consignee contacting the lorry driver on route by radio or mobile phone and advising him of the need to arrive at 12.30. Thus, leaving aside the voluntary decision by the driver to arrive early, one essential component required to achieve the change of pace is communication from the consignee to the driver that he should or must reach the destination at the earlier time.

Communication alone will not be sufficient to secure a change of pace of the vehicle. Why should the driver bother speeding-up to arrive at the earlier time even if he is asked to be at his destination earlier? He may choose, exercising his free will, not to bother complying with the request. The driver, it seems, has no particular reason to attempt earlier arrival unless there is an incentive to do so or sanction. Thus, to arrive sooner than planned at his destination he must not only receive a message that requires him to arrive earlier, but he must also decide to comply with the request. To comply, he must obviously take the view that it is better for him to arrive at the proposed earlier time than to ignore the request altogether. Put another way, he makes a value judgement.[37]

For the lorry driver, many matters might be brought to bear in that value judgement. He may perceive that his late arrival would disappoint the consignee or his employer and he fears their approbation. Perhaps he cannot find any suitable excuse for arriving late, or would be disappointed to arrive late. It may be that he would incur a financial loss by not arriving early. The deliveryman who only gets paid if goods arrive on time would clearly have a financial interest in achieving the expected delivery date. The driver may also have to weigh up counterbalancing matters. Perhaps to drive faster will mean an increased risk of an accident, or increased risk of being fined for speeding. It may be of course that the driver simply cannot go any faster, either because his vehicle is not powerful enough, or the road he faces ahead is in poor condition, or traffic is too heavy. Thus, there may be many reasons why the lorry driver would be reluctant to comply with a request to arrive earlier. Not only might the cost of

---

[37] This is corroborated by findings of value judgements within case study research. If anything, what emerged was that contractors will tend to carry out low cost acceleration measures (regardless of whether they are being paid to do so) to mitigate a large loss, but will hesitate before taking measures involving larger cost exposure, testing first to see whether they might be reimbursed the costs likely to be incurred.

the journey increase, but also it is possible that he will not arrive by the revised time. In short, accepting a request to arrive 30 minutes earlier may increase the risk of untimely arrival, an increased risk that may need to be factored into the price. Requesting arrival 30 minutes early may affect the entire price, both in the marginally higher cost of fuel and premium to reflect added risk of non-achievement.

Thus, the consignee who requires goods to arrive 30 minutes early faces two problems. First the lorry driver might not accept this request, and second, if he does accept will probably do so on the basis that the price for the journey is increased. The price increase would be sought both by way of compensation for additional cost and as a reward for the increased risk of non-performance. It is not only the lorry driver but also the consignee is put to a value judgement. The consignee must weigh whether it is in his economic interest for delivery to be brought forward. Two factors in that equation are the value of the benefit of earlier delivery and the contractor's cost of complying. A third factor to weigh is whether in attempting to complete earlier the driver will be exposed to higher risks with respect to completion that would otherwise have been the case. From a planning perspective, this scenario can be identified by achievement of planned or normal progress to a point, after which the planned rate of progress is accelerated so as to finish early.

It is suggested that construction projects are no different. For the contractor to attempt to complete earlier than planned requires communication of the revised date to the contractor, and the contractor making a value judgement, deciding that he prefers to accelerate than not to do so, a decision likely to be driven economics. The employer also needs to make a value judgement on whether the value derived will outweigh costs likely to be incurred.

Acceleration to reduce delays

The third reason why the lorry driver might increase his rate of progress is to overcome some difficulty of which he became aware since setting out on his journey and which, if he does not go faster, may result in arriving at his destination late. Obvious examples are, for example, during the journey he encounters road works or heavy traffic which delays the journey or he is forced on a detour due to road works. He may for a considerable time, find himself stuck behind another vehicle which is travelling slowly and so decides to accelerate, overtake, and make up lost time. Perhaps the driver simply underestimated the speed he needed to travel, or forgot to allow time for parking the car at his destination. Again it might be asked, why might the driver speed up to reach his destination on time? Does he not have the option of just arriving late? One might surmise, therefore, that the decision to speed up is taken because he prefers to finish his journey on time rather than late. Again, the driver makes a value judgement, whether made consciously or not. As before, this preference may be driven by economics, in that if he arrives late he will suffer a loss, by sociological matters or by personal preference.

From this example it can be seen that for the driver to accelerate the pace of progress so as to avoid arriving late at his destination requires three conditions to be fulfilled:

> First, something needs to happen after setting out on the journey, which has the effect that travelling at the planned pace will not result in arrival at the time required, all other things being equal.
>
> Second, the driver must be aware of the event and its likely impact.
>
> Third, the driver needs to decide that he wants to accelerate, by making a value judgement to accelerate, because it is in his interest to do so.

Accelerating to overcome delay can arise out of situations of complexity. The analysis above presupposes the delay was due to a matter for which the lorry driver was responsible. But what if some matters causing delay were matters for which the consignee is responsible? This puts both parties in a difficult position. If the lorry driver arrives late as a consequence of the delay, he will clearly seek payment for the goods, and seek to avoid any penalty for late delivery. If the lorry driver attempts to overcome the delay by accelerating the rate of progress for the rest of the trip, he will face the prospect of attempting to recover the cost of doing so from the consignee, perhaps by exercising a lien on the goods or refusing to deliver before securing additional payment. If, on the other hand, the consignee is advised of the delay during the course of the journey, he may request accelerative action is taken to overcome the delay. Such a scenario is equally fraught with difficulty. For what price is the consignee to persuade the lorry driver to accelerate? The consignee who attempts to secure a lump sum price may find that either the lorry driver refuses or fails to achieve the date due to subsequent delays. The consignee who suggests paying for additional costs may find he has to pay for a range of alternatives which he did not expect. Either way the consignee might have been better off merely allowing late completion. Thus, one can see that it is not only the lorry driver whose pricing is disturbed. The consignee is also put to a value judgement, one which may need to be made in a very short period of time. In planning terms, a scenario such as this is complex. During its first pre-acceleration phase the journey does not go to plan, in that it is delayed. In its subsequent phase, if the difficulty has passed the pace increases so as to finish on time. If the difficulty continues then the rate of progress will need to be increased first to overcome the effect of the difficulty and second to secure timely completion. Progress in neither first nor second phase was to plan.

Speeding up to recover lost time on a journey is characteristically different, it is suggested, from bringing forward the planned time of arrival. The first difference is that the acceleration is not driven directly by a request from the employer: it is driven by a response to a delay to progress or by a matter which has arisen which will delay completion. That response might either be by the employer, or undertaken voluntarily by the contractor. The second difference is that in order to make that response there needs to be a realisation that a response is required, i.e. that progress is or will be less than satisfactory and unless a response is made, completion by the planned completion date will not be achieved. This realisation can only be achieved if there is a method for measuring the rate of progress. If, using the analogy of the car journey, a driver plans to drive 100 km, averaging 70mph, but finds his average falling to 50mph, in order for the driver to know the extent that he is running late requires speedometer readings. He also will need either a note of how long he has been travelling at a reduced speed, or a roadside marker against which he can compare when he ought to have passed the marker against when he actually does. If he cannot measure his rate of progress, he will not know he is progressing at a lower than expected rate.

The third difference in character with acceleration in order to maintain a completion date as distinct from acceleration to bring forward a completion date, is that responsibility for its source, the delay or additional work may itself be a matter in dispute. The disputes arise because responsibility for delay will depend on (a) whether the matters which are predicted to delay completion are events that might entitle the contractor to relief from forfeiture and (b) whether those events are likely to be causative of delay. In the face of concurrent delays on the part of the contractor, and confusion over factual matters, these questions may be difficult to resolve quickly. Even if the matters which caused delay are not in issue, the appropriate quantum of damages may be a matter in dispute, and may have a considerable bearing on the perceived cost to the employer of acceleration.

C. Characteristics of acceleration

An analysis of the car journey analogy again helps to identify some defining characteristics for acceleration.

First, reference to acceleration per se is somewhat meaningless. In the case of a vehicle it might refer to a short-term reaction to climb a hill or to overtake or it might refer to a decision to travel the entire or part of the journey at a faster pace than expected. In the case of a project the change of pace may have been planned. More significant is some reference to the cause of the change in pace, and to the consequences. If the cause were due to fine weather, one would make no remark. If the cause of an increase in speed was because the driver was being pursued by the police, or because the journey time was to be foreshortened one can take the view, based on sociology or economics that the accelerating action had some worth to one or more parties involved. In other terms, there is a need to differentiate 'acceleration' depending upon the context within which it arises.

Second, whether talking of vehicles or projects, the change of pace is introduced or comes about after the start of the journey, during the course of its progress. This is clear from the car journey example above, where the acceleration was made in response to either a request mid-journey for early arrival or the realisation mid-journey that arrival would be later than planned unless some action was taken to speed up. Similarly with a construction project, acceleration occurs mid-project, after the work has started. For construction projects in particular, this carries the consequences that before acceleration, progress ought to have been as planned. Thereafter, the plan of action for completion of the project will, in part or in whole, be upset as soon as some attempt is made to change the rate of planned progress.

Third, the perceived need to accelerate arises mid-journey. Its purpose is either to alter the existing plan or to correct a performance that is not proceeding to plan. In either case, implementation of a change of pace is dependant upon on (a) the contractor's awareness of the need to alter the plan; (b) his willingness to vary the rate of performance and (c) willingness of the contractee to accept the terms of the varied performance, if any. Willingness of the contractor to change performance will depend upon the surrounding contractual, economic, psychological and sociological states of the parties and on how it is perceived the accelerative action may affect that state.

Fourth, the accelerative actions that might be taken are potentially wide ranging. In the instance of a car journey, acceleration can be undertaken not only by driving at higher speeds, but also by taking a different route, taking shorter breaks, using two interchangeable drivers, or by using a faster car. Equally, on a project, whilst accelerative action initially may only involve adding resources, other methods available are redesign of sections of work for faster supply or installation, changing construction methods, reorganising resource deployment or removing constraints to allow for example, late night or weekend working.

Fifth, as accelerative actions are a response made in real time mid-journey, those actions might not be successful in securing earlier arrival, due to some other event which delays progress later or because the accelerative actions were not directed at the constraints to progress. This is explored more in the next chapter. Similarly with construction, as a function of the way projects progress, action taken to accelerate a project will not necessarily influence the date for completion of the project as a whole. Action taken to change the rate of progress of a project may not succeed in securing timely completion due to supervening events.

A sixth characteristic is dependency upon measurement of rates of progress. If the driver does not know at what speed he is travelling, he will not know whether he is going faster or slower than planned. Where the rate of performance is said to be in delay, whether acceleration is required at all depends upon whether there is in fact any delay. It might be, for example, that the time originally allowed for performance was inadequate. The capacity to measure progress of performance will be crucial to understanding whether acceleration is required at all, and if so, to what extent the rate of progress needs to be changed.

A seventh characteristic of acceleration is that its effectiveness is difficult to measure. If the driver arrives early, then clearly the acceleration was successful. If he overcomes the road works and delays on route but accelerates and finishes on time, again the accelerative action was clearly a success. But what if, near his destination, the driver meets a roadblock. Maybe he just joins the queue of traffic earlier than otherwise would have been the case. His accelerative actions may have been wasted. Similarly with projects, a function of the complex processes through which projects are managed and progressed is that the determination, whether prospective or retrospective, of the consequences of accelerative action may itself be both difficult and complex. This may be particularly important where disputes exist as to the responsibility for pre-existing delays, or delays incurred concurrently with what is said to be accelerative action.

Eighth, if the consequences of accelerative action are to be understood, and cost of that action is to be estimated, a clear understanding is required of the progress which the contractor had intended to achieve by that stage as reflected in the contract price, and what stage had actually been reached. In the car journey, the instruments available for measurement of progress at any stage of the journey are the clock, speedometer, distance counter, and perhaps and on-board computer and a mapping system to position the driver on a map. For construction, plans are set out in the form of programmes and schedules, which are updates with progress to show, at different stages, the progress achieved. The use of programmes to plan and measure progress is covered later.

The real difficulty with acceleration, in contrast with a variation, is that whereas a variation amounts to a change in the work, and is usually easy to quantify and therefore to price. Acceleration will involve some change to the sequence in which the remainder of the work was planned to be undertaken or a change or changes of method of working, in the same way as the driver may chose to take a different route to his destination. The financial effect of such consequences can be exceedingly difficult to identify. This difficulty of either predicting or identifying the cost or value of acceleration might be regarded as a third defining characteristic.

Ninth, a defining characteristic of acceleration is that its introduction influences economics and risk of the remaining journey or project. If the driver contracts to complete his car journey for a price, the cost of completing the journey will change if he accelerates either to arrive earlier or to overcome delays. Assuming the car engine's use of petrol is less efficient at accelerate speed, the driver will spend more on petrol. If he has to change journey, he may use additional petrol for extra mileage. A different route may induce more wear and tear on tyres. The driver may also face the discomfort of not being able to take a scenic route or stop at his favourite restaurant. Once accelerative action begins, the car driver may face increased risks of fines for speeding, or of accidents.

Similar principles apply to construction projects. On all projects, save for those where the contractor is engaged on a reimbursable basis, the introduction of accelerative action to the project influences the contractor's economics and influences the extent of risk to be carried by the contractor in respect of all outstanding work from the date of the instruction. As the contractor's price estimate and time allowance for completion of the work crystallise at the time the contract comes into effect in the form of the contract price and time for completion, any subsequent event might influence the contractor's capacity to achieve performance within the price. An order to accelerate by employer to the contractor is an obvious such subsequent event.

What is the additional cost to the lorry driver of accelerating? Some of the factors tending to increase costs are referred to above, such as the potential need to change route, perhaps even the need to change vehicle, and the cost of the increased risk of further delays to which the lorry driver may be exposed in taking the alternative route. Leaving these matters aside, on the face of it there is a direct relationship between the volume of petrol used and the speed achieved. Yet if the increased speed required to accelerate takes the lorry beyond optimum performance speed, it may well be that more fuel is consumed, in that the engine is less efficient in use of fuel at higher speeds. Other car parts may also suffer increased wear and tear. Thus, even with consideration alone of base resources, the increased costs to the lorry driver are difficult to calculate; further difficulties arise were matters such as alternative routes or increased risks to be considered. The consignee is in no less difficult position in attempting to estimate the additional costs. It will suffice to note here that calculation of the additional costs, either at the time or later, will be less than straightforward for either party.

So far as project economics are concerned, were all projects let on a reimbursable basis and without a contract completion date this might cause little difficulty, for the cost of accelerating would simply fall within part of the reimbursable cost. The parties, however, let most construction projects, on a lump sum basis whereby the contractor bears, in part at least depending on the balance of price and time risks carried or shared between or. If the project is completed late, the contractor, absent interference by the employer in the contractor's performance, will bear the consequence of the delay and cost overrun unless the matter causing the delay is one for which the contractor can secure relief under an express contract provision.

D. Summary

Acceleration is introduced to projects in order to overcome local difficulties, to attempt to complete the project early or to attempt to reduce unexpected delays incurred. Its implementation is dependent upon the employer communicating to the contractor a desire that the pace of progress is altered, the contractor agreeing to alter the pace (or finding himself under compulsion to do so) and implementing a chance of pace. Whether the change of pace in fact secures earlier completion will depend upon whether there are futher delays, how work is managed and whether earlier completion is logically possible.

Successful implementation of acceleration relies upon (1) an understanding of the state of progress at a particular point or points in time; (2) an understanding of how progress is reported; (3) an understanding of the likely contract completion date in the light of progress; (4) a management system which receives and acknowledges progress data and is capable of deciding whether, and in what form, corrective action is required; (5) a management system which facilitates decisions as to appropriateness of acceleration in the circumstances; (6) Proper evaluation the cost of acceleration and (7) a contractual system or arrangement or legal framework which protects the interests of both employer and contractor in the event of a request or agreement for acceleration to be implemented.

In seeking to understand how acceleration might be implemented, and what the consequences might be of its implementation, it is necessary to understand the management systems used by those charged with planning and management of construction work.

III. How Projects Progress

This chapter leads from a hypothesis that acceleration is achieved through addition of resources. To explore and test this hypothesis two issues are explored: an understanding as to how projects progress and, from this, seeking to understand how and whether it is feasible for a contractor to increase the rate of progress.

A. The Nature and Characteristics of Projects

From a literature review, and development from first principles as set out in Appendix B it is suggested that the essential characteristics of projects are as follows: task-orientation, finality, novelty or uniqueness, and their requirement of a high level of management input for project completion to be achieved.

There are very significant differences between the production line type system and a project system. In two respects, continuity and repetition, which are characteristics of a conventional, continuous production process, projects show contrasting characteristics in that they are unique and finite. A function of this is that the third characteristic of a continuous process, control by sampling and by exception, differs in nature from the control required to achieve a project. For projects there is a need to actively manage the activities within the project itself to make it happen, rather than just letting the continuous process run. As will be shown later, these differences go to the heart of how a project ought to be managed to successfully achieve its objectives.

- Although the word 'project' is usually reserved for the achievement of a large-scale tangible result it generically refers to any production process producing a single result. Construction and engineering work, which produce tangible buildings, structures or installations, are examples of projects.
- Projects are progressed through completion of individual, unique, activities. Few projects, like tunnelling, are linear. Thus, projects differ fundamentally from linear production processes of the type seen on a newspaper printing press or car production line. The means with which individual tasks are progressed is the focus of Chapter 3
- Projects cannot be completed without integration of the different tasks. This requires significant management input in planning and controlling activities.

- The construction process is usually analysed in systems terms as an open system. Two sources of risk are the wide range of contributors and exposure to the project to its environment. Thus, projects are unique, risky, uncertain ventures.
- Projects require significant management input in order for the project to be realised. Part of that management input must be directed at responding to changes in the project's environment. The project's management organisation needs to be designed to anticipate and accommodate responses and changes.
- The implementation of acceleration is an example of action taken by a project manager in adaptation of the project's direction or objectives in response to changes in the project's environment. Either the client's requirements change requiring completion by an earlier date or the project is delayed and that delay cannot be accommodated, in both cases requiring the pace of work to be accelerated.

B. Progress of activities

This section is concerned with an understanding of progress in the context of projects. Little has been written on this subject. What follows is largely an analysis that proceeds from first principles.

According to the Oxford English Dictionary progress is defined as follows:

> **pro+gress** *n.* **1.** movement forwards, esp. towards a place or objective. **2.** satisfactory development, growth, or advance. **3.** advance towards completion, maturity or perfection... **7. in progress.** taking place; under way. *~vb.* **8.** (*intr.*) to move forwards or onwards, as towards a place or objective. **9.** to move towards or bring nearer to completion, maturity or perfection. [C15: from Latin *progressus* a going forward, from *progredi* to advance, from PRO- + *gradi* to step]...

In the conventional sense 'progress' conveys achievement over a period of time. The expression 'making progress' is synonymous with the apparent gradual realisation of an objective by completion of interim stages. Progress has two components, movement (advance) and direction (towards completion).

Movement is a necessary condition of progress. An exception is an anticipated stop for an anticipated period, such as a train stopping at a station, or a bus at a bus stop. If a car were stationary in a traffic jam, one would hardly say that progress is being made. Progress may also include a period of time when the project team is apparently carrying out no work, provided that a project participant in the widest sense is doing something towards project completion. By way of example in the construction project context, all design work might stop after an application is made for planning permission. One would nevertheless say that progress is being made as long as the relevant authority is considering the application (indeed in these circumstances one frequently says that the application is 'being progressed'). Another example would be when an order has been placed with a manufacturer for a long lead item at a stage when neither designs nor construction work is being progressed. One would nevertheless say, if the particular material or equipment was being designed or manufactured by the supplier, that progress was being made.

Movement alone is not sufficient to say progress is being made. Direction is also a necessary condition of progress. If the car is driverless and rolling backwards down a hill one would not ordinarily say that progress has been made. The car on a journey is said to be making progress if it is moving in the right direction towards its intended destination. By virtue of each mile, or even each metre which is covered provided the direction is toward the required destination, whether this takes days or seconds, progress would be said to be made. Each mile or metre is an interim stage which is completed toward completion of the overall goal of reaching the destination.

Completion of a project involves completion of the project's constituent activities. Successful completion of projects (according to Lock, 1996) involves completion within the budgeted cost, within the stipulated time period and to the stipulated quality. This view is perhaps limiting: it fails to acknowledge potential changes of circumstances mid-project, the effect of which may mean that the employer is happy to settle for completion on different terms. Progress is made when activities or tasks are being undertaken to complete the project within those objectives. In the context of a construction project therefore, 'progress' can be defined as the achievement or partial achievement of activities or tasks consistent with successful completion of the project.

Since projects are dependent upon progress and completion of activities, a detailed understanding is required, first, as to how or why activities progress at all, and second, as to what factors influence the rate of progress of activities. Both bear directly on the capacity to accelerate. Other issues examined later include:

- The rate of progress of the project's constituent activities
- The relationships between the activities
- The extent of co-ordination and integration of activities
- The extent of influence of the project's constraints and environment.

How or why do activities progress at all?

Little, it seems has been written directly on these issues. What has been written tends to focus on estimating the cost of activities (dealing with the cost sensitive elements of activities), or on planning progress of activities. Standard texts on cost estimating and time planning of construction describe how the cost of construction is estimated, and how an allowance for the time taken to do the work is calculated. Thus, to build a wall 200m long, for example, the calculations in the texts show allowances being made for materials, plant, craft labour and support labour. Yet these allowances, apart from identifying cost sensitive components, do not explain why, how, or when these elements might be available or when the brick wall will in fact be built. Similarly, all the leading texts on project planning simply suggest use of norms for planning. If experience, or in-house data, says that brickwork is typically installed at 1 hour per square metre, and the wall is one metre high, the texts suggest that the wall will take 200 manhours to install. Again, these do not explain why, how, or when the bricks and labour come to be available, all of which are necessary for the brick wall to be built. Planning alone will not secure progress. It will not suffice to have the necessary plant, materials and labour available for the work to be done.

The answer as to what is required to make an activity progress at all may best be explored by an analysis from first principles, of a very simple activity, that of a child making a sandcastle on a beach. A child arrives on the beach, and first finds a spot to build the sandcastle. Once he has found the spot, he will start gathering sand and forming the castle. To assist, he may use a bucket and spade, and his other family members or others on the beach may provide some advice or assistance. After an hour or so, the proud child may be looking at his completed sandcastle. A close analysis of this simple construction activity shows that for the castle to have been built, there were some things that had to be present, and some things had to be absent.

For the sandcastle to be built resources were necessary. First, some land, or space on the beach is needed. If the beach had been so crowded that no room was available, the sandcastle would never have been built. Equally, the space had to be appropriate, as use of a concrete covered car park may have been possible but scarcely practicable. Second, the child cannot build without suitable sand, and perhaps also some water, and pebbles for decoration. The appropriate raw materials are crucial. Third, to build the castle, the child will need to use his hands, his own labour, to collect sand and form the castle. If he has the use of a bucket and spade, it may make the task easier. The bucket and spade are not strictly speaking necessary but the task of building may not be easy or practical without them. The bucket and spade are, as resources, generally referred to as plant. Plant is the fourth element required.

These resources, space, labour, materials and plant are indispensable, but not sufficient, for the sandcastle to be built. Some destination or design must be envisaged. If the child has no idea what a castle looks like, because he has never seen one even in a picture, he will not know where to start. Some plan of a sandcastle is needed, even if only a notion in the child's mind. In fact, the help provided by a parent or sibling is likely to be directed at helping the child build a castle that will not fall down easily, advising how to erect solid walls, and how to add water to the moat without the whole castle crumbling. This fifth resource necessary for construction is information, or more particularly, design information. Finally, with all of these components or resources, there is still no guarantee that child will start to build, or complete, the sandcastle. What he needs is motivation. The motivation may be pleasure, curiosity, a parental suggestion, it may be that a competition is to be held on the beach for which the best sandcastle wins a prize, or it may be to relieve boredom. Motivation is the sixth resource required. It is not sufficient to say that motivation is part of a resource called labour. The child might have arrived at the beach and decided not to build at all, just as a labourer might arrive on site and decide not to work. Thus, for the work of building a sandcastle the child needed space, labour, materials (sand, which was readily available in this case), plant (his shovel) to make the task easier, a design to work to, and the motivation to proceed. All are necessary for completion of the task. These, at least, are the positive contributions required.

A seventh resource, if indeed that is an appropriate description for it, is that some organisational skills are required for the sandcastle to be built. Looking again at this example in some detail, the child will first level the sand where the castle is to be built, then build walls and dig the moat and finally put a flag on top. These tasks need to be carried out in sequence. It need simply be noted here, for it will be dealt with later in further detail, that the organisational contribution may have a significant impact on the way in which activities are managed and sequenced, and this in turn may influence how quickly or efficiently the project is completed.

For the sandcastle to be built, there are things which must not happen. Some consideration will need to be given, and acknowledgement taken, of the environment in which the sandcastle is being built. When the child arrives on the beach, it will be of little use picking a location which is to be covered, minutes later, by the incoming tide. Poor weather, such as rain, will stop the work of building the castle and may wash the half built castle away. Or it may simply be that the child runs out of time and has to leave the beach before the task of producing is completed. Thought is required to consider the effect of these risks to non-completion or late completion to see that these potential difficulties are minimised. This thought might be more appropriately called Organisation. 'Organisation' here, in addition to activity sequencing noted above, is a process which monitors factors external to the project to reduce the impact of external components on project progress.

It appears that there is no uniform classification of resources for construction projects. Resources have traditionally been grouped, by attributes, under the headings of labour, materials and plant. Today it is common for subcontractors to be added to this classification. Mawdesley (1997, p55) proposes that these groupings of resources derive from commonality of attributes. The grouping may have more practical basis, as this classification seems to have emerged from planning and estimating practices: these are all resources for which a direct cost to the contractor is immediately identifiable.

The sand castle example is useful in that it shows that any discussion of 'resources' for construction should not to be limited to labour, materials and plant. It should also include design/information, space and motivational influences. Organisation is required (a) to co-ordinate and to integrate resources, (b) to co-ordinate and plan in sequence different activities and (c) to reduce the risk of exposure to difficulties from outside the project's environment. The characteristics of each of these resources, and the ease with which their supply, and hence project progress, might be increased is discussed in Appendix D. For consistency, the view taken here is that design and management are both resources, helping to reinforce that each plays an essential role in bringing about the end result.

Activity progress rate determinants

Assuming resources are available, what influences the rate of progress of activities? Ignoring matters beyond the activity itself, such as the interrelationship of different activities and the various operational constraints and constraints imposed from the project's environment, there is a commonly held view that rates of progress will be increased if more resources are applied to the task in hand. Is this right? Is there any other way that outputs might be increased?

Take the car driver. If he puts his foot on the accelerator, more fuel passes through to the engine and speed is increased as a result. On the face of it there is a direct relationship between the supply of the resource and the output. If, on the other hand, an additional car was made available, the journey would take the same amount of time. If the driver had additional information in the form of maps and traffic guides, he might be expected to shorten the journey time by taking a different route. The reality is probably that he would not be able, whilst driving, to read maps and directions as his eyes would be on the road. The addition of a passenger alone might not make any difference, in that only one person can drive the car at any time, unless the passenger can read maps and guides and determine alternative and faster routes to the destination. Addition of maps and guides would probably only be effective if he had a passenger who could read and advise on routes. From this example, it is clear that addition of labour, in the form of drivers, may only have a limited on progress and addition of plant, in the form of a car, will have no effect at all on journey speed. It seems that selection of resource to be increased is crucial to the effectiveness in increasing speed in this case.

Taking the sandcastle example, if the volume of sand on the beach is doubled overnight, will sandcastles be built at twice the speed? They would not be built any faster at all. Neither would speed alter significantly if the child had ten buckets and spades rather than only one. An additional child, however, would be expected to result in double the number of sandcastles being built. In this example, addition of labour would have a direct effect on output level. Consistent with the previous example, if speed of output is to be increased then the choice of appropriate resource to be increased is crucial.

The fallacy of the resource/volume argument is also apparent when considering the simple task of baking a cake. The addition of an extra cook will not make any difference if there is only one oven. The addition of mixing bowls will make no difference if there is only one cook. Addition of more butter, flour or cherries will not, alone, produce more cakes per hour. What is needed is an increase in *scarce* resources. Applying this to the other examples, the only thing that stopped the car engine going faster was the amount of fuel entering the engine: fuel was the scarce resource upon which speed depended. On the beach, the scarce resource was children to build the sandcastles. A bucket and spade for every child is ideal, but any more buckets and spade will simply be superfluous. Importantly, as can be seen in these examples, completion of the task requires the combination of available resources in the right proportions. Output ought to rise with the addition of scarce resources, and given the need for resources to be mixed in proportion to achieve optimum output, the resource that is scarce may change as resources are increased.

The other factor that influences progress is timing. The addition of an additional bucket and spade toward the end of a child's sandcastle building may be of little assistance to the day's efforts. If additional resources are provided at an early stage, their impact will obviously influence progress of all subsequent work. Addition late in the project may clearly make little material difference to the likely completion time or date.

From these examples, three conclusions can be drawn:

(a) Two matters influence the rate of an activity's progress: the volume of resources put to use; and the proportions at which resources are mixed for the particular activity;

(b) Increased supply of resources will only affect output if the additional resources are scarce.

(c) The extent of additional output secured will also depend upon timing of the addition of more resources.

Activity resources, output and efficiency

The efficiency with which the resources are used will be a factor influencing output. The level of resources required for completion of an activity, depending on the resource in question, may be variable. The brick wall will always consume 49 bricks in one square metre, but its construction may require one or ten drawings, one or ten architects, and one or ten bricklayers. For example, an architect may undertake design work on a project and at a later stage be assisted by another architect. Similarly the number of gangs or craftsmen dedicated to erecting stonework to the elevation of a building might be varied as the work proceeds. Clearly, the cost of completing the brick wall, and time taken to complete the wall, will depend on the volume of resources allocated and on the way in which the work is done. In this respect, there emerges a key observation: the relationship between application of resources and output is not direct.[38] This indirect relationship arises for several reasons:

First, the efficiency achieved by resources deployed may depend on the extent to which other factors necessary for progress to be achieved are in place. The child on the beach building a sandcastle, if provided with ten buckets and spades, rather than just one, may be unable to build the sandcastle any faster than if provided with only one bucket and spade. An increase in labour or plant resources on a construction project may result in little additional work being carried out without a corresponding management input to see that the resource is deployed so as to achieve an increased output.

Second, the rate of efficiency achieved will depend upon both the quality of the resource and the use to which the resource is put. It is particularly notable that some resources, such as labour, are capable of being deployed in many ways. Thus, specialist welders may be capable of undertaking other tasks such as laying pipework or painting: it does not follow that the efficiency with which they will carry out both activities will be similar. Alternatively where a project has been delayed by numerous technical queries which need to be resolved, the addition of more productive labour will, in the short-term, have little influence on the rate of

[38] This also means that the marginal cost of production is potentially variable.

production. The addition of an engineer who can resolve queries may have a disproportionately high impact on production.

Third, regardless of the qualifications of labour deployed, the rate of output will in part depend upon the uniqueness of the particular activity to be undertaken. Thus, assembly of components in a prototype will usually take longer than assembly of subsequent units. This is usually because the assembly process required evolves through trial and error, or that after the first unit is assembled alternative processes are found to be more efficient.

Fourth, resources are used to progress activities. Whether a change in the rate of progress through the addition of resources affects the likely completion date of the project will depend on whether the particular activity or activities influenced by the additional resources is critical or will depend on the extent of its float.

On construction projects the relationship between the volume of resources applied and output achieved on individual activities is rarely direct. Thus, an increase in the level of resources on a project will not, ordinarily, result in an equivalent increase in the rate of output.

C. Other factors Influencing progress

1. Interdependency of activities

It was noted above that projects comprise activities, all of which will need to be completed for the project as a whole to be completed. It was also noted above that a defining characteristic of projects is interrelationship between activities. Some activities must be completed early to allow others to proceed later. Other activities must await completion of earlier activities before they can start. Thus, between any two activities there may be a relationship. They may be totally independent, or they may be connected in a way which makes performance of one dependant on progress or completion, of another. Activities are interdependent and need to be completed in a logical sequence.

The sequence in which activities are planned, and in which they are carried out, will depend upon logic. The logic adopted is of two types, that which is necessary and that which is preferential. The logic will be necessary where there can be no doubt, and it is essential for, one activity to have a particular relationship with another. That foundations need to be built before the brickwork in a wall is erected is an obvious example. Relationships are said to be preferential where a variety of possibilities exist and one is chosen on preference. Examples of each can be seen from the earlier example of the child building the sandcastle on the beach. This small project may be viewed as containing three activities: levelling the area in which the castle is to be build, forming the castle structure, and finally decorating the structure with a flag as a mark of its completion. The three activities will, necessarily, have to be carried out in that order. The logic is necessary. Were the sandcastle to have a moat formed, it may be said that the task of forming the moat might take place at the very start, before completing the castle, or after completing the castle. The logical relationship between that activity, building the moat and other activities would be preferential. Preferential logic is not necessary, but usually dictated by risk management and economics.

Similarly, to build a garden wall the activities must proceed in a logical sequence: excavation, laying concrete foundations, then erection of brickwork. These three activities must be carried out in this logical sequence for the project to be completed. Some sequences of activities may be preferential. If two walls were to be built as part of one project it may be that both could be, for example, either sequentially or concurrently. The decision as to sequences may be determined by economics, by ensuring that resources deployed were used most efficiently given the task. Thus construction of the second wall may begin after the first is part constructed to ensure continuity of work for the bricklaying operatives. Alternatively, construction of both walls might proceed concurrently in order to ensure that both are completed as soon as possible.

Logic dictates that all project activities cannot start at the same time. As some are dependent upon the performance of others, they will not be able to start before others have progressed or been completed. For the project to be successfully completed, all activities cannot finish at the same time: some will need to be completed earlier. They will need to be undertaken in a sequence which reflects the interdependencies of the project activities. The project can only be completed if activities are undertaken in a logical sequence. Before work is started, the relationship between the activities needed to complete the project will need to be understood by those managing the project. If this understanding is not achieved, there will be a risk that work will be undertaken which will be abortive. Thus, with insufficient planning may lead to removal of work carried out to allow other work to proceed, thus resulting in delay to project progress and the additional expense of abortive work.

The example of a brick wall being built highlights the need to understand the construction sequences and to plan the work, but also the potential need to prioritise activities. If construction of the brick wall comprises three activities, excavation of a foundation trench (A), pouring concrete foundations (B) and building the brick wall (C), the construction work will be carried out in an A-B-C sequence, sequentially. If a drainage channel was also to be laid (D) on the same site, it may be that this work could be carried out concurrently with either activities A, B or C. For the construction manager, an important consequence arises: the need to prioritise activities to which resources are allocated. One option, if time is not limited, is to carry out the work in the sequence A-B-C-D. If each activity takes one week to complete, the minimum period required to complete activities A, B and C in logical order, and assuming that D can be carried out concurrently, will be three weeks. In planning terminology, it would be said that activities A, B and C were critical, in that a delay to any would result in the work taking longer than three weeks. D would be said to be non-critical, and has a float period of two weeks which would need to be consumed before that work became critical. As resources available on site are typically limited, it is a key function of the construction manager to allocate resources to critical, rather than non-critical, work.

For the purposes of this study an important observation arises from this example: if the duration of a critical activity (in this case either A, B or C) were to be shortened (in this case to less than one week), the project as a whole would be completed earlier. If the duration of a non-critical activity (D in this case) were to be shortened, it would make no difference to the completion date unless the float had already been consumed. Thus, it is possible for accelerative action to be undertaken on a project which will have no effect on the date for completion of the project as a whole. Action taken to accelerate will only affect the completion date where that action influences critical activities.

2. Management of activities

It follows from what is said above that active management is required for a project to be completed. Probably the most important task of the construction manager is to allocate resources to activities in a way that (a) uses scarce resources economically to achieve completion within budget and (b) achieves timely completion. Thus, a key task for the manager is to identify the sequence in which work needs to be undertaken and to prioritise between activities.

Second, for progress to be achieved, activities will need to be mobilised to commence at a particular time in relation to other activities. This requires monitoring the progress of activities under progress and mobilising the resources required for successive activities to be commenced. Third, a motivational system will need to be in place to ensure that work on a particular activity does in fact begin, and once commenced does not cease completely. Fourth, if any attempt is to be made to manage the rate of progress of the project as a whole, progress will need to be measured. If progress is inadequate, corrective action may be required. The progress of particular activities may need to be directly managed in order to ensure that progress of the project is maintained at a satisfactory rate. Progress of non-critical activities cannot be deferred or delayed to such an extent that they become critical. Fifth, particular activities may need to be stopped, and later restarted, in order to facilitate the progress of other activities.

A key management task to achieve progress on a project involves planning the activities to be undertaken, ascertaining which at any particular time are to take priority, allocating resources to the priority activities and taking steps to ensure that those activities commence and progress adequately. This applies whether the work is being undertaken by the main contractor's own labour force, a joint venture contractor or by subcontractors.

The need to differentiate between critical and non-critical activities in managing construction work means that the rate of progress for the project as a whole can be both difficult to predict and difficult to control. With a motorcar, the rate of progress is easy to control. Speed is regulated either by pressing the accelerator or the brake pedal. The accelerator regulates the fuel supply to the engine thus increasing or decreasing speed. The brakes slow the car down. With projects this is not so. Instead, what will dictate the pace of the project is the rate of progress of only those activities which, having regard to the necessary sequence of activities, and state of progress, are critical to completion.

Baxendale (1985, p.5) concluded, in his paper on measuring site productivity by work sampling, that where productivity studies were carried out on site, they were not questioning the operatives work input, but in reality were questioning the site organisation and management of that input. Olomoloyaie (1990, p11) concluded his paper on motivation and productivity of bricklayers saying that production problems are largely managerial. He predicted that these problems could be reduced if the management on individual sites is aware of them and directs more effective action at project planning and control. Thus, it seems that the management role of planning and management of work can have a significant impact on project progress.

3. Responding to the project's environment

Resources, a plan, motivation and the co-ordination of activities will not be sufficient to secure completion of a project. Other matters, or conditions, need to be in place for a project to proceed. Returning to the example referred to above involving the child building a sandcastle on a beach, for the sandcastle to be built an appropriate position on the beach will need to be chosen. The chosen position will need sufficient sand of suitable quality, for pebbles will not do.

But in addition, some consideration will need to be given, and acknowledgement taken, of the project's environment. The chosen position will need to be in a location least likely to be affected by, for example, the incoming tide. If the tide comes in the castle might not be completed. If it rains it may wash away the sand before the castle is built. Or it may simply be that the child runs out of time and has to leave the beach before the task of producing is completed. Organisation is required to consider the effect that this external environment will have on the project and to redirect or manage differently the work if it is to be completed. 'Organisation' here is a process which monitors factors external to the project to reduce the impact of external components on project progress.

Projects are achieved through the completion of tasks or activities. With respect to some or all activities there will be constraints which will influence how that task is undertaken and how that task relates to the project as a whole. There are four categories of task constraint typically encountered.

Activity constraints: the absence or shortage of any of the factors noted above necessary for an activity to proceed

Logical constraints. In undertaking any project, it is unlikely that all tasks can be undertaken concurrently. In order for the project to be achieved the constituent activities will need to be undertaken in a way which acknowledges the logical relationship between those activities. Thus, some constraints will be necessary, because it is not physically possible to do two particular tasks concurrently. Some may be physical constraints. These are likely to be the single greatest influence on the sequence in which particular project activities will be undertaken. A road cannot be laid before the rock boulder in its path is removed. The walls of the house physically cannot be constructed until after the foundations are laid.

Legal/regulatory constraints: A variety of constraints arise through the regulatory framework through which a project is run. Thus, local by-laws may prohibit construction outside the hours of 8am to 6pm on Monday to Fridays only. Trade Unions may seek to limit the hours which particular classes of employees work per week. It is common in construction of power stations in UK for the employer to agree with the NAECI, the trade union group representing engineering workers, that the site shall operate in accordance with that organisation's rules. Those rules seek to prohibit weekend working for instance where it is possible for additional labour to be introduced to the project instead. Noise regulations may prohibit certain operations at particular times or at all.

> On a project to erect an air-cooled condenser adjacent to a power station in East Anglia weekend working was prohibited under the terms of a site-wide union agreement. Following a relaxation of the rules, in view of significant project delays, work was undertaken by the existing labour force over each weekend for several months, reducing the period of delay.[39]

Economic constraints: Projects are usually undertaken within a contractual framework whereby one or more participant undertakes to carry out one or more tasks for a price. The risk on the price usually rests with the contractor. This is also frequently the case with contractors' engagement of suppliers and subcontractors. Thus, contractors and subcontractors will usually be interested to complete the task or task which they contracted to undertake in a way which secures completion without the cost of doing so exceeding the contract price. This influences both the sequence in which work will be done and the level and nature of resources which the contractor or subcontractor will dedicate to the project.

> A mechanical erection contractor was engaged by a construction manager to install a complex pipework installation as part on a new paper mill in Kemsley, UK. The contractor's progress was delayed by late receipt of materials, all of which were free-issue from the employer. At the contractor's suggestion, once the supply of materials increased, all erection work henceforth was undertaken on a reimbursable basis. Immediately the contractor arranged for a significant increase in the volume of resources at the site and output rose significantly, albeit at considerable cost to the employer.[40]

> On a project to erect a CCGT power station in East Anglia several package contractors were in significant delay and were reluctant to increase the rate of performance in view of outstanding claims for delay and disruption induced additional cost. Some packages were converted so that all remaining work might be completed on a reimbursable basis. Immediately the volume of labour was increased by each contractor, albeit at consider expense to the employer. It was also noted that efficiency levels reduced as labour had less incentive to perform efficiently and working areas were congested, overpopulated with workmen.[41]

By way of example, in construction of a garden wall, construction of foundations could begin at one end of the area where the wall is to be built, using one man or machine for excavation. Alternatively work might conceivably begin at both ends concurrently with a man/excavation machine at either end. In practice the former is more likely, for the contractor does not want to be in the position where the work is completed within two hours whereas both machines were hired for the entire day. The optimum position will probably be one in which continuity of work is maintained and 'down-time' or non-productive time minimised. Similarly, it will probably be cheaper and more convenient to wait until the entire excavations are dug before placing concrete in the foundations. Thus, whereas the readymix concrete might have been delivered in small batches over several days, thereby allowing brickwork above to commence earlier, it may be cheaper to wait and pour all concrete in one operation. Similarly for that operation, the concrete might be compacted by hand or using a machine. A significantly different means of carrying out the work, different use of machinery, or a different sequence might be adopted where there are very significant financial incentives to complete the work as

---

[39] See Case studies, King's Lynn Power Station

[40] See Case studies, UK paper mills, Kemsley

[41] See case studies, Sutton Bridge power statioin

quickly as possible or a significant penalty for failure to complete by a particular date. In either case, these are examples of the sequence of work, and the resources to be used for the work, being influenced by economics.

In respect of the constraints noted above, it will be noted that some, such as physical constraints, are necessary and others, such as those dictated by economies are preferential. Some constraints may affect particular activities to be undertaken whereas others will affect the entire project.

It is noted that the use of preferential logic by different parties to the project can produce peculiar or undesirable results for some parties. On a larger project where piling is to be undertaken, a sequence of piling may be adopted in order to ensure that the non-productive time consumed by the plant is minimised. This may result in a sequence which favours the subcontractor, in that it achieves completion of the piling work in the most efficient way for that subcontractor, but which is not necessary in the best interests of the project as a whole. This applies particularly where the sequence is one chosen by a subcontractor. In practice the project may require a great deal of piling to be undertaken early on in the project, which may involve the use of several subcontractors, and a small volume of non-critical piling work later.

What is clear from the above is that removal of constraints to progress is an alternative means of accelerating progress, independent of the introduction of any, or any significant, additional resources.

4. Changing methods of working

Increasing resources is merely one step toward accelerating progress of an activity. Another is to adjust the balance between the various resources so as, for any particular activity, to increase the rate of efficiency and hence progress with which the work is carried out.

Returning to the earlier example of the child building a sandcastle, the typical child might start to build his edifice in the early afternoon, gathering sand up, mixing sand with water, moulding the moist sand in his hands and placing it in position. The entire task may be completed within two hours. If more water is provided, then the rate of completion is unlikely to improve. So too with increases in supply of sand or space. Improvements will only be achieved to a given performance with an increase in the supply of scarce resources, in this case, the child's labour. But what if the task was to be done in a different way? If sand were to be packed into a bucket and upturned, the bucket may act as a template, and may result in a shape which resembles a castle. Thus, the same resources, one child, sand, a bucket and shovel, may achieve the task of building a sandcastle more quickly by tackling the task in a different way. Changing the way in which activities are performed is, therefore, another means by which progress rates can be improved.

The same principles apply to the largest construction and engineering projects. There are currently at least three methods by which a concrete floor slab for an office block might be formed.

> The traditional method involves assembly of formwork by carpenters from timber, laying out reinforcement and pumping in concrete, allowing the concrete to set and, after a curing period, removing the soffit formwork and later removing props after full strength is achieved. With slight variations depending on climate, the same technique is used world-wide. Timber formwork is inexpensive to purchase but requires much labour to assemble the forms. The first method may consume, on a floor to floor basis, a cycle of about 3 weeks
>
> A second method is to use a table form, which is a large formwork deck and supporting structure designed for rapid erection and dismantling, and to proceed as in the first method. Table forms are often made of aluminium framing, making them light, expensive to purchase, but suitable for reuse for years. The advantage of the table form is that it can be quickly assembled, dismantled and lifted from one floor to the next. This second method secures a time saving in erecting and dismantling formwork, and might see an erection cycle of two weeks. The design of the floor slab may have to be modified in order to accommodate table forms.
>
> A third method, used on steel frame buildings, is to layout a permanent sheet metal deck, lay reinforcement and pour concrete. This obviates the need for any temporary formwork, and may see one floor being executed per week. Clearly the use of a sheet metal deck requires alterations to the design of the slab, and involves use of different permanent materials for incorporation into the works.
>
> The fourth method involves procuring a sufficient area of slab from a precast concrete manufacturer, hoisting the slab sections into position, and adding concrete to fill the gaps between the precast concrete units. Work to the upper floor can commence almost immediately, with installation taking only a matter

of hours.

Whilst one element of work can be erected by different construction methods, with different erection periods, it does not follow that there will be sufficient time, mid-project, to change from one method to another. The change from the first to the second method assumes the availability of table forms. It also presupposes a slab design which easily facilitates use of table forms. Thus, design changes to profiles of concrete structures might also be required. The change to use of steel decking or precast flooring during construction would scarcely be achievable. Considerable redesign of structural details and connections would be required. Further and in any event the lead-time for procurement of the steel decking or precast flooring is likely to be so long as to prevent their use without causing considerable delay to the project. Any design changes may require approvals from third parties, and may affect other design areas such as services and finishes,

> On a project to convert and old school into an old peoples home in North London a great deal of the existing roofing, flooring and brickwork was to be retained. Soon after demolition work started it was noted that extensive temporary works would be required to keep comparatively small areas of flooring and roof. The contractor volunteered in rooms where more than 30% of flooring was to be removed, to remove and replace the entire floor, and made similar arrangements with respect to the roof and internal walls. In the event the contractor incurred more expense through funding additional material costs but saved considerable time, labour cost and avoided complex and expensive temporary works through judicious alternative methods.[42]

> A contractor planned to erect the tower to a office block in Egypt by conventional reinforced concrete means. This was changed, so that a slipformed core was inserted first, allowing rapid construction of later floors. This was thought to have saved over two months in time to erect the frame, allowing other trades to commence earlier than expected.[43]

> A tenderer for a contract to erect an exhibition hall in Midlands UK noted that there would be insufficient time to order the specified cladding system if delay was to be avoided. He suggested an alternative design was used. After winning the contract a new design was selected allowing cladding to be ordered for timely delivery. In the event it was found that this was a false economy, as the system ordered required a secondary steelwork structure and the time to install

[42] The project, with which the author was personally involved during the course of the works, was for conversion of Munro House, in Hampstead, London.

[43] The project was for construction of the Headquarters of MISR bank in Cairo, a project with which the author was involved in evaluating claims.

that additional structure delayed the project unexpectedly for almost two months.[44]

The obvious conclusion to draw is that where work has to be achieved in a shorter period than planned, serious consideration should be given to changing the method of achieving the end result having regard to the time required for redesign and procurement lead times. The relationship between design and method, in the context of consideration of alternative methods of working, may be important. If the employer's design team had specified that a floor is to be constructed of in-situ concrete, the use of precast units is unlikely to be considered without a wider realisation that the specified materials might also be changed.

The capacity to change construction methods and sequences will increase where design changes (a) do not affect other elements of work (b) can be made speedily by the design team and (c) the design change is not delayed by regulatory approvals or client approvals.

D. Summary of matters in Chapter 3

The matters set out in this Chapter were concerned with testing the hypothesis that acceleration is achieved by addition of resources. There are a number of findings:

- The rate of progress for the project as a whole is dependent upon (a) planning which distinguishes between critical and non critical activities; (b) progress of critical activities (c) sufficient progress of non-critical activities so that their float stays above zero and (d) minimising the impact of project constraints or influences of the project's environment. To progress, to the time scale planned, priority must be given to activities that are critical.

- The factors influencing the rate of progress of activities differ from the factors influencing the rate of progress of a project as a whole.

- Projects are progressed through activities. Activities are progressed by application of the necessary resources for the activity in question (labour, materials, plant, space, information, subcontractors) under a framework which provides motivation. The rate

[44] See Case Study for National Exhibition Centre, Birmingham.

of progress of any particular activity will depend on (a) the extent to which those resources are deployed and having an appropriate balance of resources available for the activities in question with motivation for performance; and (b) the extent to which other constraints, whether logical, legal/regulatory or economic, can be limited or removed.

- For projects to progress, it is necessary that there is available an adequate quantity and supply of resources, plans and specifications, motivation, management to co-ordinate the work and some organisational framework to ensure that the delays from external events are minimised.

- For the project to be completed, all activities must be completed. The minimum time taken to complete the project will be the time taken to complete critical activities. The time for completion will also be dependent upon the success or otherwise with which risk both internal and external to the project has, and is, being managed.

As a consequence of these findings, contractors can accelerate the rate of progress by various means:

- Increasing the rate of progress of individual activities, by increasing the volume of scarce resources applied to the work, with the result that the activity durations are shortened. This will only accelerate progress of the project as a whole where activities being accelerated are, or become, critical.
- Changing methods of working and changing sequences of activities
- Removing or reducing the influence of constraints to progress, whether logistical, logical, regulatory or economic.

Hence, addition of resources is but one way in which acceleration might be achieved. It might also be noted that addition of resources is not a necessary condition for acceleration. Indeed, it is possible for additional resources to be added with no resulting acceleration of the project achieved.

IV. Acceleration: contractor's costs incurred

This section tests two hypotheses: First, that contractors necessarily incur additional cost through accelerative action; and second, that the likely additional cost is difficult to forecast. It does so by initially reviewing the basis upon which work is priced and proceeds to review constructions costs by category, assessing the impact of accelerative actions. As with earlier sections, this section is largely developed from first principles.

A. The relevance of cost

In this chapter an analysis is undertaken of the potential categories of increased cost consequent upon acceleration. The approach taken here is to identify the sort of additional cost that might arise and, where relevant, to identify from the case studies similar or divergent approaches taken in claims made by contractors.

Contractor's costs are of relevance to this study in three respects:

- First, it is noted from the case studies that acceleration is rarely instructed without some consideration of likely costs. Indeed, there was a noticably high incidence of employers that thought the impact of accelerative actions would be £nil or of little impact. The decision to accelerate, (whether made by contractor or employer) about which more is said earlier, is more likely to be made against an economic analysis, however superficial, that compares the estimated value to be secured from accelerating against the perceived cost of doing so. Potential cost exposure is likely to be in issue well before any decision to accelerate is made.

- Second, contractors and employers evaluate the benefits and costs of acceleration from differing perspectives. Contractors are interested in quickly calculating the likely cost of acceleration in order that it can negotiate an acceleration agreement with the employer on terms that would secure a profit or at least not expose the contractor to serious risks of incurring a loss. The employer might be interested to understand the likely cost of acceleration in order that he can decide whether acceleration is appropriate at all or, if so, at what price? An attempt is made below to set out areas of additional cost that the contractor incurs, and thus the employer may face, consequent upon acceleration.

- Third, it may be important to distinguish costs being incurred by a contractor, and damages consequent upon a breach. An understanding of areas of potential cost is therefore of considerable importance in deciding on the extent of acceleration desirable

The expression 'costs' is apt to mislead. For the purposes of this chapter, it is the cost to the contractor. It may be either an additional expense to which he is put, or a loss incurred. The costs consequent upon each method of accelerating will be explored below, using those categories. It excludes incentive payments to the contractor but would include incentive payments to labour, staff or subcontractors.

B. Classification of costs incurred

Different professions use the term 'costs' in different ways. Economists differentiate between fixed and variable costs. Accounting systems typically are structured with cost centres, allowing local budgets to be set and actual costs to be measured against the budget. Construction companies usually separate each project as being a cost centre, with separate cost centres within its head office, for example. In reporting, a distinction is made between income generating cost centres and the others, typically administrative and head office functions that operate on a non-project specific basis, generally referred to as overheads. The term overheads may also be used in various ways, on the one hand being head office overheads, and on the other being the administrative, management and establishment costs on a construction project, generally called 'site overheads'.

Here, a distinction will be drawn between costs incurred as a function of time, and those incurred according to the volume of work carried out. An example of the former is site accommodation for senior site staff, which tends to be incurred as a function of time: Costs incurred, regardless of the volume of work to be done at the site, are time related.

Construction costs are usually split into three categories:

- Direct costs, being the costs directly associated with, and which can be allocated to, particular items of work. The direct cost includes materials, labour, plant, and usually, amounts paid to subcontractors;

- Indirect costs being cost incurred in respect of matters which cannot be directly allocated to particular items of work; and

- Head office overheads. Whilst this is notionally part of indirect costs, a division is usually made between site overheads, being those that arise directly for the project on the project site, and central or head office costs, covering central administrative and management functions.

As will be seen below, the cost of accelerative action may influence each or any of these categories. Losses fall predominantly as loss of expectation. Where the productivity of labour or plant is reduced, the contractor's difficulty is that he will expend additional sums on labour and plant in return for the same income. The other category of loss is through opportunity forgone, such as the loss of a chance to use resources to earn profit elsewhere.

C. Measuring acceleration related costs

Measurement of costs incurred by contractors is not a complex matter: even the smallest contractors maintain basic accounting systems that record transactions and costs incurred. Several account issues can present challenges. One, for example, is allocation of head office costs to projects. Another is measuring cost with precision at a particular point in time, for this requires views of work in progress, accruals and accounting for potential recoveries from claims. The third area, which is less an accounting issue and more one of entitlement in the event that certain events occur, is the extent to which costs incurred exceed contractual expectations. It is in this third area where attention is needed if contractors are to recover costs incurred as a consequence of accelerative actions.

In the measurement of the additional cost consequent upon acceleration, several basic accounting principles are suggested:

First, Third, the additional cost or loss should be measured on the basis of actual, rather than notional, loss.

Second, care should be taken to avoid duplication. This is most apparent where a resource is used for productive work, and further resources introduced which are also to be engaged in that productive work, there is, prima facie, no additional cost involved, as the additional resource merely aids discharge of productive work. Losses, particularly due to reduced productivity, may of course be suffered, but this would be overcompensated were the contractor to be paid the entire cost of the additional resources introduced. Duplication may also be apparent between acceleration and prolongation claims, and recovery in the variation account.

Third, care should be taken to taken account of compensating advantages. These, it would seem, are potentially twofold. Where a contractor succeeds in completing a part of the work earlier than expected due to accelerative work, the time-related indirect costs which would otherwise have been incurred for the saved duration are necessarily saved. Second, where the project as a whole is completed earlier than planned, the contractor's resources ought then to be released earlier than might have been expected, so providing to the contractor the opportunity of earning a contribution to overheads and a profit.

It should immediately be noted that if, at the date that accelerative actions are ordered, the entire contract is put on to a different footing whereby the entire project is run on a reimbursable basis, the question of the extent to which costs might exceed contractual allowance might exceed the contract sum or a budget does not arise. Such a change to contractaul relations has at least the merit of administrative convenience. But as noted from Case studies[45], even reformulation of all work on this basis may not eliminate disputes, particular where the costs in fact incurred exceed expectations and where parties involved take the view that part of the spending increase was solely contractor generated.

The balance of this chapter is concerned with costs incurred in the context of a lump sum contract and where, as a consequence, there will be some interest in measuring additional costs incurred. The 'additional' costs fall into a number of categories.

---

[45] See Case Studies for Paper mills at Kemsley.

- Readily identifiable additional costs incurred. These include staff, labour, plant, accommodation and the like. Some differentiation is required, however, between costs that would have been ordinarily incurred and those incurred as a consequence of acceleration. Thus, purchase of materials for incorporation into the works would always have been required: the premium paid to a courier for express delivery might on the other hand be an example of costs arising only from acceleration. On a lump sum contract, measurement of the increase is against the costs implicit within the contract price.

- Another form of additional cost manifests in expenditure on work or resources that exceed the planned expenditure, sometimes seen is less output secured from the resources planned requiring more to be invested. These may be referred to as a loss of expectation. Thus, where a contractor expects an earth moving machine to move 10 tonnes of excavated soil in one day, but in fact only moves 7 tonnes, it might be said that a loss has been incurred, in that the plant's output is lower than planned. Care is needed here, for the loss might alternatively be measured in terms of the additional cost incurred in hiring additional plant, or hiring plant for a longer period, to get the planned work done.

It follows from the above that proper identification of 'additional' cost requires a proper understanding as part of the evaluation as to how the original contract price was made up, including especially assumptions made about resources or planned sequences of work or techniques envisaged. Some complex analysis may be required to fully understand the extent of losses given the need to compare with the contractual expectation.

D. Reliance upon the Contract rates and prices

Part of the additional costs incurred in accelerative actions will be incurred through changes in method or through changes in deployment of resources resulting in reduced unit productivity. In some instances, such as changes in methods used to carry out work, the loss might only be evaluated as a total cost claim i.e. the difference between actual cost (excluding factors within the contractor's control such as inefficient working or the cost of remedying defects) and what it was anticipated they would cost. In respect of the latter, the adequacy of their original tender is necessarily put in issue.

Compilation of a contract sum as part of tendering is conventionally carried out in two stages: first estimating the project's anticipated cost to the contractractor with additional of an allowance for overheads, margin and risk, followed by tender adjudication[46]. So far as this study is concerned there are a number of observations that can be made:

- The calculation of the tender price is a multi-stage process from which the employer only sees the resultant price. A breakdown of the tender price, whether by trade package or even in bills of quantities is unlikely to assist in understanding the many underlying assumptions used in preparation of the price.

- Pricing of particular elements of work is typically carried out by a norms-based calculation of the number of manhours required to complete the work. Calculation on that basis presupposes efficient use of resources consistent with past projects. With the exception of large plant, a detailed evaluation of resource allocation at that stage is unlikely.

- the adjustments made during the tender adjudication process, and pricing of particular risks, may produce a price considerably different from that prepared by the estimator. Thus, when addressing what was the contractor's planned position, absent acceleration, care will be needed to consider whether the alleged rate of performance, is consistent with the time and money estimate, or the contract price and contract period. How particular risks were priced may be less than clear.

- The sum total of the estimate may differ from that in the tender. The contract sum may be different again if subsequent adjustments are made.

An issue noted in case studies, and evident in any event from evaluation of contracctors claims, is that tenders are typically prepared in short periods and that contractors are generally required to submit a price and programme only. Thus, little or nothing might be declared at the time to the employer about construction methods proposed or resource plans. It may even

46 The material set out here is derived from research carried out on tender preparation and price build-up, as set

be that little or nothing is noted internally on these issues by contractor's estimating teams or bid leaders. The absence of these documents provides a weak evidential base upon which claims might be founded and can result in more contention during evaluation of additional costs.

E. Direct costs

This part involves analysis of the impact of cost against each resource type. In researching this section it was necessary to have a detailed understanding of the characteristics of the resources in question, and particularly the capacity for the resource supply to change to facilitate planned accelerative actions. Details of that research are set out in Appendix D and are not repeated here.

1. Components and Materials[47]

The ease with which the supply of materials required for incorporation into the works can be increased, or dates for delivery brought forward, depends on four factors: extent of design required of the materials or goods to be supplied; the extent of off-site prefabrication before delivery; stock availability; and shipping arrangements.

If the materials are standard, they will be available from stock. If that is the case, little additional cost will be incurred in the short term save perhaps for marginally higher prices paid for supply at short notice or for express delivery to the site.

Where the materials are not available from stock, the cost incurred in shortening supply periods will depend on the materials involved. Costs involved may include paying for manufacturers overtime, paying allowances for gaining a priority slot within the manufacturers assembly programme, paying for additional costs incurred through subcontracting work where use of subcontractors was not intended and paying material premiums and extra delivery costs, both for raw materials and the completed product, which may be incurred. Manufacturers' prices depend upon economies of scale and benefits of

---

out at Appendix C.

[47] For convenience, temporary materials are considered below as part of plant.

planned production to counterbalance higher off-site assembly overheads. The cost of securing proprietary products that are purpose designed may exceed by 100% the price otherwise payable. Site management costs incurred arranging these may also increase.

Prefabrication requires labour, plant and space. The benefit of prefabrication, which is assembly under controlled conditions, and assembly away from the site, will be in part obviated by the cost, if any, of hiring space for prefabrication, storage and transport to site. Where site labour is involved in prefabrication, the additional costs will be limited to the cost of hire, or clearing the additional space, the cost of transporting labour and materials to and from the additional space, and consequential indirect costs, such as supervision and security costs. Where pre-assembly is undertaken by third parties away from the site, the second potential additional cost conceptually is the difference between the cost incurred in paying manufacturers to assemble the goods and deliver to site and the cost if the equivalent work was done on site by site labour.

The economics of factory style fabrication differ markedly from site production. High production costs, driven by expensive plant and machinery, a trained workforce, a clean environment and overheads for administration, marketing, sales, premises and management, can only be recovered through high level of production. This necessitates use of planned production runs. The price quoted by the manufacturer to prefabricate goods off site at short notice may, of course, be many times the equivalent site assembly cost for it may have to factor both production costs and cost of disruption to the existing production schedule. The manufacturer, potentially in a monopolistic[48] position in the short term, may command a premium price to compensate for disruption to his ongoing manufacturing schedule. Every householder knows that a bedroom wardrobe can be purchased in kit form for £100 and assembled in 4 hours at home whereas the same wardrobe may cost £300 to buy in its assembled form. Some prefer to pay the higher price for the completed product to avoid the trouble of home assembly and time consumed. The same principles apply to construction projects. This is particularly the case on projects where space on site is limited, such as joinery work for hotel bedrooms. Whether assembled by site labour or by third parties, costs are likely to be incurred in lifting the pre-assembled goods into place, costs which may exceed the cost of lifting individual components into place for in-situ assembly. Householders also know that the difficulty with purchase of an assembled wardrobe from a retailer is that delivery may only be possible at certain times, and with payment of a delivery charge. Construction projects are no different in this respect.

Where the sequence of work is changed, additional costs may be incurred through installing materials or goods later during a later stage of construction than originally intended. There will be a marked difference in cost between receiving on site a factory formed water storage tank that is lifted directly to the roof space and lifting each piece individually into the roof void from below after the roof is in place and assembling the tank in the void.

With respect to the cost of shipping goods to site, alternative transport may be available, each with a differing cost base. A change from one basis to another may reduce time for delivery to site and/or reduce time to place goods in place.

In summary, acceleration driven increases in material costs are likely to arise through payments to prefabrication shops for labour and management time consumed; additional costs to secure faster delivery of materials; or the additional cost of a wholly different product which is preferred because it can be installed faster. The latter category may include cancelling orders already placed and paying a premium to secure products at short notice.

2. Plant

Contractors can increase plant use by (a) gaining further use of plant already available and/or (b) introduction of new plant:[49] both have financial consequences.

The cost impact of gaining greater use from plant already on site ought to be limited. The additional costs arising from acceleration measures would ordinarily be limited to payment for non-productive overtime premiums required for overtime by drivers, if required under the plant hire agreement. If plant is hired on an hourly basis, similar premiums may also be incurred in respect of plant itself.

---

[48] Shortage of time when considering acceleration usually precludes contractors seeking competitive quotations.

[49] See Appendix D.

So far as additional plant is concerned, a distinction needs to be drawn between plant used for productive work and other plant. Hire of additional plant to carry out productive work would not ordinarily result in any additional cost. But for the acceleration, the plant would have been required at some stage in any event. Three potential categories of loss are, however, identifiable:

- Carriage and mobilisation costs[50] will be incurred which might not have arisen had existing plant worked on site for a longer period; and

- Losses incurred due to reduced plant productivity. A cause is likely to be due to more plant on site to serve the same volume of work, thus increasig the periods during which plant is not employed on productive work. Introduction of plant tends to reduce the unit output of the plant concerned, giving rise to a loss of productivity. The loss consequent upon acceleration is not the cost of the additional plant per se, for that plant is put to productive use, but the reduced output per unit of plant.

- Costs consequent upon changes in sequence. Tendering on fixed priced contracts tends to be on the basis of the most economically efficient technique. The need for work to be done within a shorter period can result in extensive use of temporary works or a completely different approach to the work. Thus, bridges can be cast in-situ. Forming the entire bridge off-site, and lifting the completed bridge into place in one movement will achieve faster erection. Costs may be incurred in crane or transporter hire that might otherwise never have been required. Against this, however, would need to be credited the costs that would have been required with falsework and the like under the originally conceived method. Identification of the additional costs might better be made on the basis of a comparison of the costs of the entire construction operation. In view of the scale of change involved, costs in this category can be very significant.

This view is borne out through the case studies:

> Roofing and cladding to new exhibition hall was to be erected by lifting sheets to the roof by a tower crane for their installation. After acceleration commenced it was decided that the tower crane's facility would be allocated

[50] A premium may be payable for transporting plant to site, particularly where none is available locally.

solely to other work and dedicated 'cherry picker' mobile platforms were introduced which allowed erection from a mobile platform that was based within the footprint of the building. The platforms were expensive to hire, but allowed erection to proceed at twice the pace. After considering the cost of the platforms, it was later found that cost of supply and erection of roof sheeting had risen 60%.[51]

Installation of curtain walling to a city centre office block was delayed due to non-performance of a subcontractor. In an effort to recover lost time, the entire perimeter of the building, at each floor level, was temporarily boarded so as to provide a waterproof environment inside in which work could proceed. The eventual cost of temporary cladding, which stayed in place for over three months, and which required scaffolding support, cost forty times the amount anticipated at tender stage.[52]

In a project to erect a seven-storey office block floor slabs were to be cast insitu using quickforms that could be released within 3 weeks for reuse. In an effort to increase speed an additional set of quickforms was hired to reduce the floor to floor cycle to cycle to just under 2 weeks. In the event some four weeks was saved but floor erection costs were doubled as a consequence of use of the additional forms.[53]

It is clear from analysis of case studies that plant costs can show dramatic increases as part of acceleration efforts. Analysis suggests that the usual rationale to introduce more plant is on the basis that lack of plant is constraining erection teams. This can result in significant increases in volume of cranes, lifts and hoists to circulate materials and staff, regardless of economics. The usual difficulty, again evident from case studies, is that where claims were made on the basis of additional plant introduced, there was an evident tendency on the part of contractors to claim the whole cost incurred, rather than making due allowance for the marginal costs only or productive benefit secured. For this reason, plant claims will rarely succeed when pleaded on a costs incurred basis.

Where plant hired does not relate directly to productive work (an example would be additional site accommodation) calculation of the additional costs incurred ought to be made on the basis of actual cost from the date of acceleration less the cost that would have been incurred but for acceleration measures. Care is required where plant is introduced at the time of acceleration that ought to have been on site in any event.

---

[51] Case Study for National Exhibition Centre, Birmingham

3. Labour

An increase in the volume of labour working on a task may be increased by (a) increasing outputs from existing labour, (b) existing labour working longer hours and (c) introduction of additional labour resources.[54]

The additional costs incurred in increasing outputs cannot be summarised shortly. They will, it is suggested, be dependant upon the action taken to increase productivity.

- Where plant is introduced, the additional cost will be the cost of the plant. Plant is considered elsewhere.

- Where subcontracted labour is introduced, the additional cost will be the cost of employing and maintaining the service labour to the extent that they are not engaged in productive work;

- Where output is increased by use of a modified design, costs incurred will be those incurred during loss of productive time whilst the design is changed and in familiarisation with the change, (this might in part be compensated by the time saved in performing to the new design). Abortive costs may be incurred through cancellation of materials already procured or removal or adjustment of materials already installed;

- Where a bonus arrangement is introduced, or modified, the cost will be the cost of administering the arrangement, and the new or additional bonus payable.

- Where other demotivating factors are removed, the cost will be that that of improving conditions, providing shelter or mess facilities or whatever means are employed.

Where the existing labour force works longer hours, the financial consequences are threefold. First, to the extent that time worked exceeds the standard hours in the working week, it is common practice in most parts of the developed world for labour to be paid a premium rate. In

---

[52] Case Study for MAFF Offices, London

[53] Jupiter House, an office Block at South Quay, London, E14.

[54] See Appendix C.

UK for instance, the following arrangement is not uncommon. Construction workers work a standard 44-hour week. This is made up of 8 working hours per day from 8am to 5pm with a one-hour lunch break, and working for four hours on Saturday morning. All overtime during the week and on Saturday afternoon is paid at 'time and a half', that is to say, a 50% premium is payable in the hourly rate for each hour worked. Where overtime is worked after midnight during weekdays, on a Sunday or public holiday, a 100% premium is paid. These payments are often referred to as non-productive overtime. The contractor is thus put to the expense of paying non-productive overtime to his labour, and also incurs additional costs in respect of emoluments that relate directly to the payments made to employees. This is usually limited to National Insurance liability. According to the standard accounting conventions in construction companies the allowances in respect of sick pay or redundancy are related to the basic pay only. In addition, however, the employer may be put to reimbursing additional expenses incurred by labour, particularly in additional lodging allowances for working over weekends. A compensating deduction may need to be made, in such a case for travel home costs that would not be incurred.

To the extent that overtime is worked, additional site establishment costs are also likely to be employed. The working hours of most sites are limited to the standard working week. Thus, to the extent that time is worked beyond the standard week, indirect costs will also be incurred for time-related indirect costs required for labour to work such as for supervision, lighting, plant and scaffolding.

The contractor may also suffer a loss from labour working overtime. The loss comes in lost productivity. It is well known that the productivity of labour falls as working hours increase. Proof of the extent of the loss may be extraordinarily difficult, but may be achieved by comparing productivity before and after the extended hours were worked.

Where new labour is introduced to activities simply by reallocation from other activities, it is unlikely that significant costs or losses will be incurred, save for the time taken to transfer and to understand the work to be done. Where new labour is introduced to the project as a whole, there will be several consequences. First, mess huts, changing rooms, other site accommodation and plant will be required. Second, supervision will also be required. Third, induction costs may be incurred. This will include the agency fees for hiring labour, time paid, but not worked, for finding local lodgings and for special site inductions. Fourth, where there is a larger volume of labour working on site concurrently, it may be that further access stairs and scaffold structures are required to allow access to workfaces.

> On a project to erect a new paper mill, all pipework was to be supplied free-issue to the pipework contractor's premises where large sections were to be prefabricated and then delivered to site for rapid installation. Delays were incurred in delivery of materials. In efforts to save time it was decided that all materials would instead be delivered to the site and fabricated on site. This, in the event, did not save any time as site erection provide less efficient that factory work. Site labour costs considerably exceeded factory wages and efficiency levels at site were markedly worse. The cost of site erection was also found per pipe to be 60% higher than factory assembly.

By far the greatest cost likely to be incurred will be related to lost efficiency. This can arise either due to frequent reallocation of teams between tasks. More likely, space in particular works areas on site will be limited. Introduction of additional labour inevitably results in congestion, with consequent dramatic lowering of productivity with potential losses of productivity. This will be compounded by existence of other constraints such as lack of information or lack of materials.

4. Space.

It was noted above that increasing available space in which to carry out work, whether on site or off site, can increase efficiency and speed of work.

Loss or gain of available working space per se on site is difficult to measure: it is usually a consequence of another operation, the cost of which may be more easily identified.

Space related costs are more likely to be found where the contractor secures additional space off-site. This may be required for storage of materials, as space to prefabricate components (particularly where the work was not hitherto due to be prefabricated) or to rehouse site accommodation to a neighbouring house or structure to release areas on site for productive work.

> An example is evident in the case studies. A project to erect an air-cooled condenser required erection of a steel-frame as a first stage. Steelwork was due

> to be delivered to site in an order to facilitate rapid assembly and erection within the limited space on site. In the event, steelwork was delivered in the wrong order that reduced the available assembly space at the site. To alleviate the problem, a neighbouring site was hired. Steelwork was transferred to this other site, allowing a greatly increased space for storage and assembly. This area was subsequently used for assembly of other components, thereby shortening the time required for installation.[55]

Second, and more complex, is working space. It follows from what was said above that releasing to offsite increases working space. So also will adoption of different working methods that require less work in-situ. An example of this is substitution of internal walls to be constructed of blocks and plaster, which may take some weeks to properly build, and their substitution with plasterboard drywall systems that can be erected in a matter of hours. Cost in use of the substituted materials will probably be consumed in cost to prefabricate or purchase alternative goods. The third method simply involves early completion of a section of work thereby releasing earlier the working space for subsequent operations. This carries the risk that the work may be superfluous and arguably unnecessary.

> On a shopping centre development a basement was to be formed by installation of a diaphragm wall at ground level and later excavation of the enclosed space. There were delays during installation of the wall, and additional diaphragm wall plant was brought to site to allow two areas to be progress at once. As a result the wall was completed earlier. In the event this was expensive and reduced in little benefit to the project. The cost of introducing the second special plant at short notice meant that a 30% premium was paid for both plant and staff. Second, the later stages of diaphragm wall work were not critical: it was the first section completed that was critical to allow substructures to commence. The acceleration of the end of the diaphragm wall work was largely a wasted expense, as the succeeding trades had not also been set up to take advantage of its early completion.[56]

5. Information.

Regardless of the party charged with carrying out design work, additional costs may be incurred in several respects. First, as design work is provided by specialised labour and plant (Computing facilities), comments with respect to labour made above apply here also. Thus, non-productive overtime costs to design staff may be incurred.

---

[55] Case Study for Kings Lynn Power Station

[56] Case Study for Galleries Shopping Centre, Bristol

Second, where additional designers are introduced, their productivity can be expected to be very low, due to the time required for familiarisation with the project or a part thereof, project systems and organisational structure, time taken to understand aspects of the design. The productivity of additional design staff will largely depend on the nature of the task to which they are allotted. Clearly, new members of the design team will more easily undertake isolated tasks than tasks requiring a high level of integration with other aspects of the scheme. The addition of contributors increases the need for supervision, and integration, through meetings, inter-team communication, which require design co-ordinators or managers. That supervision and integration work is essentially non-productive.

The third area of additional cost may be in the premiums paid to design subcontractors. In view of the highly specialist nature of design work, it may be that the design team face little alternative, due to limited resources internally, to subcontract a proportion of work. The cost of so doing, at short notice, may command a premium to reflect the lack of competition for the work, the short notice period, and the speed with which the work is required.

6. Subcontractors

The greatest area of cost exposure to which the contractor is likely to be faced is in amounts payable to subcontractors. Conceptually, such sums that ought to be due will replicate those above which might be incurred by a main contractor himself. But a contractor also may incur considerable costs and losses to reflect the change to a subcontractor's conditions. Costs incurred will typically fall into two categories: the price payable to the subcontractor to alter its plans, and sums to reimburse the trade contractor additional expenditure to which the subcontractors are put.

The core difficulty with subcontractors is that they may be hired on a basis of start and finish dates, or a period of weeks in which work is to be undertaken. They have, within that time, freedom as to how work is undertaken or in what sequence, and this may greatly inconvenience the main contractor. The amount payable to the subcontractor to overcome this may be simply the amount sought. The lowest level of cost may come from an arrangement whereby the subcontractor agrees to carry out work to different sequences and with additional resources provided the contractor agrees to reimburse additional costs. The cost of resolving disputes as to what is said to be additional may be considerable. The difficulty with these arrangements is that they may expose the subcontractor to additional costs through reduced output, a loss he will inevitably look to the contractor to reimburse. In practise, it is this perception of additional loss that the subcontractor seeks to recover, either through a price for accelerating or by direct reimbursement of losses or costs incurred.

Were the contractor to define an alternative contractual basis, such as substituted completion dates or milestones, the subcontractor's price for compliance with those milestones can be expected to command a substantial premium in order to account for increased risk. A further premium may in practise be incurred to reflect market conditions, i.e. that the contractor may not have time to seek quotations from other parties. In practise, this can be tantamount to paying for work on a reimbursable basis.

Where the contractor wishes to achieve control over all aspects of the subcontractors work, he may have no option but to agree that all subsequent work be carried out on a reimbursable basis. The costs incurred may exceed expectations by a considerable margin, as is seen from examples below:

> On a project to erect an extension to a paper mill pipework was procured separately for delivery to a fabricator so that large sections were delivered to site for rapid installation. In an effort to reduce time the construction manager suggested that pipework, instead of being remotely fabricated, be assembled on site by a site based contractor. This was perceived to be necessary due to delays in materials supply. Site assembly costs were found to be 80% higher per unit, due to site management arrangements and space available, than factory fabrication.[57]

> In construction of a new cement mill complex all electrical work was to be completed by one date. During the project the construction manager realised that sectional handover was preferable. To accommodate this certain sections of subcontract work had to be prioritised. The subcontractor assented to this after agreement that all prioritised work was undertaken on a reimbursable basis. Unit costs for that section rose some 30%.[58]

> On a project to erect a power station, the engineering contractor reprogrammed the work in efforts to accelerate. Contracts with the works contractors were varied from a lump sum to reimbursable basis as a means of encouraging them

[57] Case Study for UK Paper Mills in Kemsley, Kent.

[58] Case Study for New Cement Mills, Rugby.

to complete the work to the new programme. In the event, the cost of completing vastly exceeded expectations, as work carried out on a reimbursable basis could not be as readily controlled.[59]

7. Changing methods of working

The additional cost of alternative methods of working ought, prima facie, to be easily evaluated by pricing each and establishing the difference between original and actual methods. Two difficulties arise with such an analysis. First, consideration needs to be given to the extent to which additions are made for indirect costs. Second, it is possible that the change of method adds significantly to cost of the particular work, but results in a shorter duration for the project as a whole. In this instance, consideration needs to be given to compensating advantages arising from earlier completion. By way of example, the water tank to the roof of an office may take one week to lift into position and fix, delaying other work for that duration. An alternative may be to erect the roof and install the tank insitu, by installation in parts. This latter solution may cost many times more than the cost of installing a pre-formed unit, but may provide a saving in the overall duration required.

Where sequences of working are said to have changed some causation issues may arise. It may be, for example, that the contractor was already minded to change working methods before any consideration of acceleration.

F. Indirect costs

Indirect costs typically include site overheads such as site staff (managers, supervisors, engineers, cost managers) and the ancillary site accommodation, some substantial plant such as tower cranes, and head office costs.

An appropriate means of categorisation of indirect costs is according to characteristics. Two categories are commonly used: time-related cost and volume-related costs.

Time-related costs are those incurred as a function of time. These are costs which, in management accounting terms, might be regarded as fixed costs. Examples include site

[59] Case Study for Sutton Bridge Power Station.

accommodation, the cost of site security, the salaries of contractor's staff that will always be required on the project, and plant that will always be committed to the project. For a construction project they are fixed in the sense that they will be incurred over the life of the project. Where a project is delayed, it is commonly acknowledged that the contractor is put to additional expense, in that he will incur additional time-related costs, through retaining resources for a longer period. As well as being put to additional expense, the contractor may also incur losses as a function of time, in that an extended project duration may deprive the contractor of the opportunity to use his resources on other projects and thereby recovering a contribution to overheads and earning profits. It should also follow, as a matter of logic from the above, that if the project is to finish earlier than planned, a saving in time-related indirect costs ought to be expected.

Thus, an important issue noted here is that accelerative actions can result in savings, in this instance to time-related overheads. It is notable from case studies that contractors do not offer credit for saved time-related overhead costs where time is saved, or proposed to be saved, as a consequence of accelerative actions[60]. This might usefully be contrasted with a different approach taken in preparation of tenders, where contractors may go to considerable lengths to work out construction methods that might deliver short construction periods in order to save time-related overheads.

The failure on the part of contractors or professionals to identify these savings may arise from the notional basis upon which overheads are typically calculated: they do not naturally fall as 'additional cost' but ought, it is suggested, to be accounted for as part of the cost impact of accelerative actions.

Volume-related costs are those incurred as a function of volume. Labour, materials, mobile plant, temporary materials, and supervisors fall naturally into this category. The extent of cost incurred will depend on the volume of work carried out. Where the contractor is asked to carry out additional work, he not only incurs those costs but may also incur losses. Losses arise, for example, where the cost per unit of work is higher because it was disrupted leading to a reduction in productivity.

[60] From research, only one instance has been noted where a contractor noted that overheads might be saved through accelerative actions: see the Island Crossing Case Study.

These categories are not necessarily rigid. Importantly, the categorisation relies on the characterisation, not on the description of the item. Thus, site accommodation which houses the project manager may be regarded as a time-related cost, in that it is a cost incurred for as long as he is required on site. Other parts of the site accommodation used as mess huts for site labour might be regarded as volume-related, as the volume of huts may change depending on the volume of labour engaged on the project.

Presumptions with respect to the latter are not without difficulty. Whether an evaluation of this potential 'advantage' is viewed prospectively, at the time when the decision to accelerate is being considered, or historically, when the cost of accelerating is being evaluated, the evidential burden would appear, in practise, to lie with the employer. Proving that early release of resources due to early completion has provided the opportunity for a greater return may be difficult to discharge. This presupposes the availability of opportunities. In a weak market, it may be that the contractor has little opportunity to tender for profitable work. According, use of formulae typically deployed to show the level of overhead and profit lost consequent upon delay, used instead to show overheads saved due to time saved is likely to be a crude measure, and to provide optimistic views, as to increased opportunity to earn overhead and profits.

Regardless of whether volume or time-related as with labour staff productivity levels can be expected to drop with introduction of more staff. The effort required to implement acceleration may be considerable and largely a pure overhead.

Whether any additional costs, losses, gains or savings are made in indirect costs as a result of accelerative measures will be largely a function of causation. Where part only of the work is accelerated without impacting the overall end date, it appear that little or no impact on indirect costs can be expected.

G. Conclusions

The opening hypothessis was that identification of acceleration related costs is difficult. The better conclusion may be that identification of costs per se is a simple matter. More difficult is identification of costs over and above contractual expectations where initial assumptions were not disclosed.

Where 'additional' costs are claimed there is likely to be an issue as to whether these costs might have been incurred in any event or at a different time to achieve productive work in which case the costs would not be 'additional': the achievability of the original tender programme and price will be in issue. Recovery of costs on a reimbursable basis, on the other hand, should do away entirely with the need to make loss-based claims.

In claims for acceleration costs contractors tend to focus on additional costs incurred. But accelerative actions can also result in costs savings. This is particularly evident in the cost consequences of chosing alternative construction methods or in savings in overheads. Analysis suggests that acceleration ought to realise overhead-earning resources to other projects earlier than anticipated, resulting in a gain, rather than an expense.

The second hypothesis was that additional costs is difficult to forecast. What is evident is that the likely cost impact of accelerative actions differs between different resources. The cost impact might be measured provided the relevant resources involved, and the impact of each, is properly understood. The cost impact of accelerative actions can possibly be predicted, provided the range of resources involved is understood.

Accelerative actions can result in cost increases. Acceleration does not automatically result in additional cost being incurred by contractors. It is quite possible that, due to tendering errors or discovery of new working methods or new subcontract or design arrangements post contract acceleration might result in no cost effect or even a cost reduction.

Looking at particular resources, additional cost of materials can arise from the need to order at short notice from a restricted market or through additional costs of transport to site. Where large plant is introduced, the loss is likely to be a loss of efficiency (as it is put to productive work). Similar comments apply to claims in respect of labour costs. Some costs are easily identified, such as payments for non-productive overtime. Others, such as loss of efficiency, will be more difficult to make out. A shortened project duration might also result in reduced overhead charges.

This chapter has been concerned with costs incurred by contractors. It was noted here that expenditure might not automatically result in either a change to date for completion of the immediate work or to the date for completion. That depends also on other contraints. Hence, expenditure on accelerative actions can be incurred fruitlessly.

V. Addressing the Employer's need to accelerate

This and the next chapter set out the outcome of research into the state of the project before acceleration; the choice of accelerative actions; negotiation of commercial arrangements and settlement of structured commercial agreements. This chapter explores the first two, and commercial arrangements are reviewed in the next chapter.

A. The employer's position pre-acceleration

One of the initial aims of the research was to study and test a generally held view that sucessful acceleration on projects could be accounted for by simply adding more resources to the project. It has been seen from earlier chapters that addition of resources may well bring about acceleration, provided additional resources are applied to the critical work and that addition of resources to non-critical work may be largely inefficient. From the employer's perspective, it became apparent through research that the outcome of acceleration actions, and particularly the cost of accelerative actions taken, was a function of three matters: the state of the project before acceleration; the choice of accelerative actions; and commercial arrangements. This chapter explores the first two, and commercial arrangements are reviewed in the next chapter.

A review of the case studies shows a number of recurring features of projects at the pre-acceleration stage. These are each explored below. There are significant in that they show areas of particular difficulty that are noted as having influenced the scope and cost of accelerative action taken. It follows that failure to act on these issues may add significantly to the costs incurred in accelerative actions carried out. Sucessful identification of similar features of projects should assist in identifying cost effective accelerative actions.

The Project was in delay.

The need to accelerate might be identified in one of three ways: when a project is progressing to plan but, due to an external impetus, is required to finish earlier; when the project is in delay and the employer wishes to avoid or reduce delay; or where some additional work is requried that would require more time but the employer asks for this to be done within the time left for completion without any extension of time.

All case studies fell into the second category. So far as the latter category is concerned, no significant examples were found in research. Many isolated examples were, however identified on projects based on the NEC ECC form where the employer had sought a quotation for a prospective change on the basis that no extension of time would be allowed, and it was priced accordingly. Acceptance of the quotation thus resulted in some accelerative action under the existing contract, rather than requiring a separate acceleartion agreement. Acceleration in this way, however, is entirely dependent upon the contractor providing quotations on this basis.

The extent of delay was unclear

From the case studies, a repeated feature emerging before any accelerative measures were contemplated is the employer's uncertainty with respect to (a) the extent of delays to date; (b) the likely date for completion, in the context of delays reported to date; and (c) the extent to which further delays might be incurred.[61] From analysis, uncertainty over the extent of delay is noted as having arose during the project for several reasons, as set out below.

First, progress reports[62] provided by contractors typically advise on the progress achieved of each activity in progress. But many other matters may be left unsaid: the activites that are critical to completion, the extent of delay on critical activities when measured against the contract programme, or the likely date of completion based upon the critical activities. A summary of delay to date is usually an approximation, the basis of which is not explained. Further the prediction of future performance is invariably provided on the basis of planned rather than actual perforamance, even though this may be patently unachievable, and may exclude changes or variations introduced to the project. It was noted within the case studies that progress reports required careful examination and analysis to discern the true position, and project teams did not undertake analyses due to time pressures, even in the face of widely conflicting progress data from different sources.

Second, uncertainty arose from misunderstanding, or lack of information, as to which activities were critical, or how the critical path was calculated. Thus, a programme based on

[61] Generally the future impact of ongoing delays was not reported, and thus not considered by the employer during construction.

construction activities alone showed a different crtical path to a programme based upon both design and procurement activities.[63]

Third, and perhaps most signficant, either the employer was denied access for further programme and progress details (such as subcontractor programmes) or it was not in the contractor's interest to provide further details. The employer is ordinarily reliant upon others for progress reports. Where work is carried out under traditional arrangements, both employer and consultants rely to a large extent on the contractor's detailed progress report with respect to ongoing construction work. These may report with accuracy the progress of ongoing activities: a quite misleading impression may be left as to the likely completion date.[64] The architect and engineer may independently report on design and also comment on construction progress (perhaps disagreeing in part with details or conclusions in the contractor's report), and where a project manager is employed he may also provide a progress report, albeit usually a summary of what others have reported. The employer may receive reports from several parties prepared on entirely different bases. A report from the contractor will usually be based solely on work already carried out. A report from the architect or engineer may incorporate views based on work that the contractor ought to have, but has not yet, carried out. Another party, such as a project manager, may highlight matters not referred to by either contractor or architect. The position is rarely different where the contractor is engaged to carry out work on a design and build or turnkey basis. Reports from various parties will differ depending on the role played by the party on the project, on the information available to that party, and on how that party chooses to represent or present an analysis of that data. Many project managers and employers in case studies realised later that the level of faith which they had given to contractor's progress reports were over-generous: a more sceptical view might have been more appropriate.[65] They should not have had such a high level of confidence in the contractor's reported likely date for completion, particularly where work is in delay.

---

[62] See the detailed review of reporting methodologies and practices in Appendix E.

[63] At the Case study for Sutton Bridge Power Station, work was reported as being on schedule when measured against construction activities, twelve months after work started on site. When measured against the critical off-site pipework procurement and fabrication, a delay of four months was evident.

[64] At the Case Study for Sutton Bridge Power Station, a large installation involving some 2,500 activities, progress was shown on tables with just a short annotation of the estimated period of delay without any particulars as to how that amount was calculated. It was just a mathematical average of activities underway, and so ignored whether activities were critical .

Fourth, the contractor had little or no incentive to to disclose any more information than contractually required.[66] There was a notable tendency in case studies for contractor not to highlight delays to activities that might have been matters for which they alone were responsible, and hence not matters for which they might have been awarded an extension of time.

Where the contractor is engaged to carry out work on a design and build or turnkey basis the employer may not have the benefit of the architect's or engineer's views unless he engages a consultant to monitor performance. Faced with conflicting progress reports from various sources, the employer may easily find himself in the position where he does not know which party's report is the more reliable.[67]

Reporting was noticably influenced by the matters said to be causing delay and the contractual framework within which the parties operate. It was also noted that architects, engineers and surveyors similarly showed conservatism in reporting on their own progress, mindful that they too may be identified with causes of delay to the project.[68]

The causes of delay were unclear

There were two noticable factors that resulting in much confusion over causes of delay. First, as noted above, contractors, in progress reports, tended to advise on progress without commenting on causes of delay, unless explanation was self-serving. Other causes were only made apparent in response to queries raised at site progress meetings, and indeed such accounts were contested at a later date.

Second, it was rare that just one cause of delay operated alone.[69] It is more likely that several

---

[65] See case study for National Exhibition Centre where delays were not to steelwork but were dismissed, when in fact these were critical.

[66] Thus, explanations as to why delays have been incurred are noticeably sparse mid-project until the contractor has a clear view on the matters for which he wishes to raise a claim.

[67] From Case studies, on the Leuna Refinery project there were the following range of views, within a year of construction commencing, of progress achieved: the contractor said work was on progress; a lead supplier said the project was behind by one month; and the employer calculated that the project was behind by four months.

[68] On Rugby Cement Works, it was noted that the construction manager made no reference in partnering progress reports of any difficulties of the contractors own making.

[69] On Victory House case study, which involved refurbishment and fitout works to seven floors of a building,

concurrent causes of delays are found. Even in respect of the same event there may be arguments as to which party or which matter in fact caused or contributed to delay. A related difficulty, in the absence of detailed knowledge of particular situations, was that views on concurrent causes of delay held by parties other than the contractor and subcontractors were necessarily impressionistic.[70] A related difficulty was that little attempt was seen to be made, pre-acceleration, to secure a greater understanding of these issues.

By way of example, the contractor may complain at having received a detailed drawing late from the architect. Even if this is patently the case, the architect may seek to argue that provision of the drawing was dependent upon receipt of certain specified information from the contractor, and that the information was received late (and therefore the contractor 'caused' the delay). Alternatively the architect may say that the preceding activities were in delay in any event so that had the contractor received the drawing any earlier it would have made no difference. The effect of this concurrency may lead to selectivity in reporting. Progress may be attributed to elements of work that may not be critical. There may be other matters in progress, particularly procurement of materials, goods and subcontract packages, which are in fact critical and in delay but which pass unreported. Contractor and architect alike may honestly believe that their view is the more appropriate or the proper view. Even within the design team there will often be different views as to what is critical, what has delayed progress, and what the likely completion date might be.

The sum of these factors explain why the employer, engaged on a project in which some delay is occurring, will not ordinarily, particularly under traditional and turnkey procurement regimes, have a predicted completion date upon which he can attach particular certainty.

Responsibility for delay was unclear

A point observed repeatedly was of an employer in a somewhat confused state, faced with a contractor in denial of delays, or proclaiming with great confidence that delays can be recovered, with other members of the project team given reports otherwise, and little guidance

---

different period of delay and different causes of delay were reported on each floor.

[70] On the Victory House case study, the architect took the view that the delay to completion of the ground floor was due to late delivery of the reception desk, a delay thought to be the contrctors own fault based on a conversation overheard..

as to the future course of action. Attempts to research or rationalise views on causes of delay, progress or as to what work was critical were generally not evident in case studies.

In this context it was noted that parties behaviour was not conditioned by receipt of an extension of time or the lack of it in the short term because (a) when received, it ws long past the event and (b), the extension of time award was seen as a further matter to be negotiated.

Interest in achieving completion by a designated date

The likely date for completion will, during the course of the project, be a matter of concern to the employer. From employer's perspective, it will be the date he takes possession. Upon this date may depend commissioning, relocation, fitting out, stocking or immediate revenue generation from sale of the facility to a third party or by way of income from his use of the facility or sale of a leasehold interest. Project completion will usually be significant in terms of financial arrangements.

In Chapter 2 above it was noted that different employers have different interests and needs with respect to completion. Some can accept late delivery of the facility with little impact;[71] some can tolerate late completion but will be interested in recovery of delays even if it involves incurring additional costs;[72] and some employers have an absolute need for timely completion.[73] Clearly the incidence of acceleration will be highest in the latter two categories.

The employer typically wished to secure completion the project's construction as soon as was reasonably possible, consistent with the business' financial and operational constraints, so that the facility could be put to use.[74] It was also noted in Chapter 2 that the need for timely completion in each case might also be viewed in economic terms: the value put on timely

---

[71] For example, if a school's new facilities are planned to be completed in June, but are in fact not required until start of term in early September of the same year, a delay of two months will be of little concern.

[72] For example, the late opening of a restaurant or retail premises may seriously impact on the store's financial performance, especially where trading is due immediately when construction work is completed.

[73] This occurs where the facility is required for a fixed date event such as the state opening of parliament, or Olympic Games.

[74] On a school project in Norfolk with which the author was involved its contracted date for completion was June 2002, but the project was in delay by two months. The board of governor and local education authority were not minded to take any positive action to recover delays as the new school term did not commence 15 September 2002 and the building would lie idle if finished earlier. (Catton Grove Middle School rebuilding after fire damage).

completion ought logically to reflect the likely liability should timely completion not be achieved.

Two notable aspects of completion were apparent from case studies. First, acceleration was not sought on financial grounds alone, as a means either of saving project cost or to lessen the value of time-related loss and expense or delay damages. Second, cases where acceleration was introduced were characterised by a strong interest in a particular date for completion[75]. Hence, there was less interest in the extension of time award that might be made, and significantly greater interest in achieving timelu completion. In virtually all projects in the Case Studies the need to achieve timely completion was a priority, or valued highly. As an expection, it was noted that acceleration was introduced to some projects as a means of reducing risk of delays or further delays to completion[76].

Securing timely completion may also be of concern to others also, particularly lessees, users and funders. Private sector projects might be initially financed through short-term project finance. At completion, the facility may be sold or refinanced on medium or long-finance, possibly through long-dated bonds. The latter bears a lower risk to the lender, may be available for as much as 100% of the value of the facility and is considerably cheaper. Davis (1996, p223) noted that provisions with respect to the date for completion should be of particular interest, and concern, to lenders. He suggested that lenders should their consider potential liabilities should the completion date not be achieved. The lender providing project finance will be concerned to see that sums advanced are geared to progress, so ensuring that sums are used for the purpose of the project. Lenders dependent upon cash flow from the completed facility will understand that delays in completion of the construction phase will involve both additional interest expense and will lengthen the repayment profile. Although Davis was commenting specifically on the lender's perspective of construction of a waste treatment plant, those comments are clearly capable of wider application.

Disparate views as to how acceleration might be achieved.

---

[75] This was especially so in the case of schools or a university that was required to be completed by the start of the new school year (De Montfort University) or where a part of a power station was require to enable more substantial parts to function. (Stations at Barking Reach, Sutton Bridge and Kings Inn)

[76] See case studies for Galleries Shopping Centre, diaphragm wall; and Rugby Cement where steelwork was accelerated.

There was no common view found in case studies as to how acceleration might be achieved. In one, the project was rearranged to be completed on a cost reimbursable basis with little apparently exploration of alternatives. In others, much discussion was held over methods of accelerating progress of selected elements of work. Some cases were characterised by small identifiable measures, others by widespread instructions.

It was particularly notable that acceleration considerations focused in each case on what the contractor could achieve. Little focus was evident with respect to what actions could be taken to alleviate matters that might be causing delay, or how the design team might contribute to accelerative proposals. There was, in each case, an obvious presumption that the design teams could accommodate changes to meet the contractors revised needs in the event of accelerative measures being taken.

Uncertaintly as to the likely cost of accelerating progress

It appears from the case studies that concern is evident in two cost-related respects before accelerative measures are introduced: (a) uncertainty over the likely final cost in view of delays incurred; and (b) uncertainty over the likely cost of accelerative measures.

The employer rarely has a clear idea, during the project, of the eventual total liability where the project is in delay. This is principally because claims for additional cost will either have not been made at this stage, or if made will not yet have been settled. As noted above, to the extent that the contractor is awarded an extension of time, he will be relieved of liability to the employer to pay damages for delay. In addition, in the event that delays to progress are due to specified causes, and the contractor suffers a loss or incurs additional expense, such loss and expense is compensable. Thus, where there is a delay due to late variations which delays the date for completion, the contractor may receive both an extension of time and compensation for losses incurred and additional time-related expense to which he is put. If the delay is due to bad weather, he is granted an extension of time but no compensation for time-related losses: if the delay is of the contractor's own making, he will suffer the relevant losses himself.[77]

[77] These features recur throughout the JCT standard forms and many other similar forms.

It is rare, however, during the course of the project for the cause or causes of the delay to be clear. They are frequently contested when presented in applications for extension of time. Even if clear, or where causal events are apparent, the consequences of those events in the face of other concurrent difficulties, is often a matter in contention. Causal analysis, or schedule impact analysis, is time consuming involving collection of factual data, analysis of data and interpretation of results.

There are several reasons why such an analysis during the course of the project is, for all practical purposes, generally not undertaken mid-project. The time required to carry out analysis can be extensive. More often that not, even for the contractor, factual data will not be readily available. Time is required to gather, organise and progress data. Where information needs to be secured from project participants there is usually reluctance to divert resources from activities directly related to progressing work for the purpose of retrospective analysis. The expense of analysis is often difficult to justify unless it is clear that there are disputes involving large sums. For the employer the position is worse. He will be reliant upon others to advise him of various difficulties on the project, may receive in the short term at least a somewhat biased view from the design professionals and will rarely have factual material available in any event to carry out anything other than the most rudimentary analysis. It appears, nevertheless, that although the architect may not award extensions of time until well after delays are incurred and the project completed, so that extensions are, so to speak, granted retrospectively, the likely extension has little influence during performance of the project on the likely completion date. Such a determination will, however, influence the final outturn cost of the project to the employer.

The above will tend to reduce what confidence the employer may have with respect to any claims he may intend to pursue to recover his losses. Reliance upon recovery of damages for delay may be imprudent without a detailed consideration of the risk of non-recovery. There is a risk, where the project is in delay, that loss may not be recoverable. He may also face, at the time unquantified, claims for compensation from the contractor in delay.

Timing, in the context of understanding the causes of delay, is crucial. The contractor experiencing difficulties procuring subcontract work is unlikely to report this to the architect where it might be perceived to be a matter that is the contractor's responsibility. Where a collection of matters arise it may be less than clear which is causing delay, which is influence progress of work, and which is influencing project completion. Immediately a delaying matter arises, its likely effect may not be apparent to any parties. The architect may only be advised some weeks later. So far as the compensation for delay to which the employer may be exposed is concerned, the employer will rarely have a clear idea of likely liability. Particularised claims for compensation take time to prepare and are rarely prepared within three months of delaying events.

A practical issue, noted in retrospect on many case studies, is that the employer at the time did not have a full appreciation of the scale of delay-related costs he already faced. This arose because of the time taken for claims to be prepared by subcontractors presented to main contractors, who later passed these claims on the employer.[78]

Limited time and opportunity to act

The limited period within which accelerative proposals were evaluated and implemented was variously noted. The evaluation period varied between a few days[79] to many weeks. Acceleration opportunities were lost as each day passed.

Issues of note from the above

The pre-acceleration period was characterised, typically, as a period where there was little certainty over the extent of delays incurred coupled with an interest in bringing out a correction within a short period. It is against this context that the decision to accelerate was made. It follows, and indeed it is evident from Case Studies, that employers will have difficulty framing acceleration requests and controling costs or likely exposure in the absence of some certainty over base issues. Greater focus on where acceleration efforts are best directed are therefore likely to have a considerably lower cost exposure.

---

[78] This was noted on National Exhibition centre, Maff Offices, Sutton Bridge Power Station, and New Cement Mills at Rugby.

[79] Case study for Kemsley Paper Mills, where the decision to convert the piping trade contract to be carried out on a reimbuseable basis was made following one meeting.

B. Issues to be considered before requesting acceleration

It is well known among construction professionals, and evident from case studies, that introduction of accelerative measures will not always achieve the planned results. Moreover, the incidence of successful deployment of measures, at the planned cost, is thought to be very low. From analysis of case studies, there are several consistent themes evident as to why acceleration measures were of only limited success:

- The contractor's chosen understanding of "completion" differed from the employer's requirements but this was not apparent at the time.[80] The usual result is that so-called completion was achieved leaving, in reality, a great deal of work to be achieved post-completion. The need to carry out that post-completion work in fact prevented occupation by the employer,[81] or meant the facility could not be used to its full potential pending completion of that work;[82]

- The extent of delay pre-acceleration was under-reported or not fully understood.[83] This meant that the extent of acceleration required was in fact greater than originally thought. Alternatively the delays were overstated, in which case acceleration was sought by contractors to a greater extent than was probably necessary;[84]

- Where limited sections of work were accelerated, the critical path to completion in fact ran through other work, so accelerative efforts were largely futile;[85]

- Unrealistic or excessively optimistic acceleration proposals were made. Typically, with detailed design for work toward the end of the project incomplete, the allowances

---

80 See MAFF Offices, National exhibition centre, Kings Lynn Power station, Leuna Refinery, The Galleries project and Wood St offices.

81 Case studies for Kings Lynn Power Station and Leuna Power Station

82 Case study for Victory House.

83 Case studies for Exhibition hall, Birmingham where there were many outstanding design issues that the main contractor had 'excluded' from the acceleration proposals; and UK Paper Mills, Kemsley, Sutton Bridge Power Station and Barking Reach Power Station, where the extent of design detailed yet to be carried out was not fully appreciated.

84 Case study for Great Pulteney Street office refurbishment, and Galleries Shopping Centre (M&E work).

85 Case studies for Galleries Shopping Centre (where completion of diaphragm wall work, in reality, was not critical to completion but was accelerated); Rugby Cement Mills were acceleration of steelwork was futile due to difficulties with successive work; and DeMontfort university where an isolated part of the works was accelerated

for time to complete proved, in the event, to be too short;[86]

Learning from this, there are, it is suggested, several key issues employers should address before accelerating:

- By when, and in what form, is completion needed to satisfy the business case? This is largely a matter for the employer, in reviewing how and when he proposes to use the facility, and the relative value he might put on early completion of some or all of the works;

- How much time needs to be recovered through accelerative measures and how might this be best or sensibly achieved? This is largely concerned with progress achieved; and how progress might be improved;

- What is the potential impact of the proposed accelerative measures on the project's risk profile? Is it exposing the project to additional and unacceptable risk?

- What acceleration measures do others (this includes project team members such as designers, and external bodies such as approvals authorities) need to take to accommodate the contractor's acceleration efforts? Are the acceleration measures proposed achievable in the light of third party performance?

- On what commercial terms are the accelerative measures to be secured? The existing contractual framework will need to be considered as its provisions may need to be varied or supplemented by agreement with the contractor.

The first three issues are addressed in the remainder of this chapter, with commercial issues being addressed in the next chapter.

---

to little effect in view of greater issues on other sections of work.

[86] Case studies for Exhibition Halls, JP Morgan Bank, the Galleries Shopping Centre (M&E work), Victory House, and UK papers mills.

C. Assessing Completion needs

From review of case studies, three observations relevant directly to completion have been observed: the first, evident in nearly all case studies, was an exclusive focus by employers in their acceleration requests on the required date for completion. But the completion required and referred to was completion for occupation or use of the facility immediately. Inconsistency between this and "practical completion" by the date for completion was typically not identified until later, to the disappointment of the employer. Hence, some consideration must be given to the state of completion required before acceleration, both for planning and, if necessary, to amend contractual definitions of completion. The question for the employer is "where do I want to get to?"

A second difficulty noted was that contractors successfully reduced the volume of work to be carried out before practical completion as part of their acceleration measures, by deferring some work to be done post practical completion. This was not anticipated by employers, but was reluctantly accepted in an effort to occupy the facility at the earliest opportunity in view of ongoing delays. This was noticeably evident on commercial projects,[87] and less prevalent on process projects where the entire process had to be in place before the process would operate.[88]

The third matter noted as recurring was that accelerative measures, when first mooted, applied to the date for completion of all of the contract works. This contrasts with actual completion in the event, where sectional or partial completion was very common,[89] suggesting that acceleration may originally only have been required to part of the works or that only limited acceleration was possible.

These difficulties are reviewed in greater depth here in order to draw conclusions as to how

---

[87] See Case studies for National Exhibition Centre, Victory House, and The Galleries shopping centre, where the definition of completion changed from 'Shell and Core' completion to the need for completion to allow the centre to commence trading.

[88] See case studies for Oil Refinery at Leuna where the definition of completion was changed so as to allow essential units only to be completed first, and Kings Lynn Power Station where the main engineering contractor mistakenly agreed that completion of the Air Cooled Condensors would be at Mechanical Completion, which allowed the subcontractor to continue for a further three months on site fixing handrails, metalwork and painting the whole installation.

[89] See case studies for National Exhibition Centre, De Montfort University, Oil Refinery at Leuna, The Galleries Shopping Centre, Kings Lynn Power Station, Sutton Bridge power station, Victory House offices, New Cement

these might be avoided.

Practical completion

It is well known, and well documented, that the term Practical completion as used in the standard form of building contract is undefined, and causes much confusion. On the face of it, work is certified as practically complete when the volume of work to be carried out is *de minimis*, leaving only latent defects to be rectified. In practice, practical completion is often awarded at an earlier stage, at the earliest opportunity that the employer might take occupation. By this stage, there may be much incomplete work and a multitude of obvious defects to be rectified. These works are then carried out after practical completion, whilst the employer is occupation.

It is notable from case studies that changes or clarifications to the definition of completion are common as part of acceleration agreements. Some changes have favoured employers: others have favoured contractors.

In the event that the business' requirements change which demand an accelerated completion, or if there is a request for delays to be reduced through accelerating the pace of work, this process inevitably increases the focus upon the nature of completion in fact required. This may result in amending what were formerly inadequate or.inflexible completion arrangements. It is also noted that reconfiguration of completion arrangements under what may be called an acceleration agreement may result in significant changes in the defined state of completion to be provided at the revised completion date. This may, or may not, work in the employer's favour, depending upon the precise agreement.

> By way of example, the contractual date for completion of a large petrochemical installation under construction in Eastern Germany was November 1997. The contract documents described at length the completion stages and testing procedures. They described the products to be produced by the plant, but for the entire complex, for a project with a value of £1.3bn, only one completion date was stipulated. Certain funding grants to be made available by the European Commission were dependent upon completion of the project by November 1997. Thus, completion by this date was, apparently, crucial, if grants were not to be lost. Nowhere in the funding documentation,

---

Mills in Rugby, and Great Pulteney Street offices.

however, was any description made of what the expression 'completion' represented. In the event, the project completion arrangements were adjusted in order to provide for sectional completion where such sectional completion had hitherto not been required. The first sectional completion date under the revised arrangement provided for a minimal volume of crude oil to have passed through no more than two out of twelve units at the plant, thereby producing a 'product'. This proved sufficient for the purposes of securing funds from the European Commission grants, although the plant in the event was not fully operational for a further eight months. This is an example of how a change to the definition of completion, or as to what work is to be completed by particular dates, with some work apparently reaching 'completion' earlier that the existing project completion date, can provide 'accelerated' completion without any change to the pace of work on site.[90]

In a project to refurbish offices in central London (Victory House) it was suggested, following delays on site, that the contractor should accelerate so as to facilitate timely occupation of the building. In the event the employer took occupation in stages. The contractor left many parts of the works incomplete upon occupation, and deferred some works to be carried out as 'post-completion' works, including all work to a file storage facility at basement level. It would appear that the employer, when arranging for phased possession, had not fully understood that the contractor's proposals involved, in part, redefinition of the state of completion to be expected at each stage.[91]

On a project to erect an air-cooled condenser at the site of a new power station the contractor agreed to accelerate to achieve completion of work as shown on his programme by the original date for completion. In fact that programme did not show any testing or commissioning. The contractor duly completed the structural work by the due date, when it became clear that the 'completion' anticipated by the power station operator was completion so as to put the facility to use.[92]

In defining the state of completion required, it is noted that projects are but transitory means to an end, to provide the employer with a completed facility. Completion, in the sense understood conventionally by businessmen, is completion so that they may run their business. Some employers will agree to occupy or use facilities at the earliest practical date notwithstanding minor work outstanding and defects to be remedied, so long as the facility is safe to occupy – as is typically the case with office blocks. For others, such as a retail facility, the employer may require premises free of contractors, with the entire facility in good working order so as to avoid interference with his ongoing trade and to avoid damaging business

[90] Case Study for Leuna Refinery

[91] Case study for MAFF Offices, Victory House

[92] Case study for King's Lynn Power Station.

confidence.[93] In practice it may be that contractors in fact return to complete work and remedy defects outside business hours. At the other extreme is a facility such as a microchip plant where the facility will need to have achieved a zero defects state before it can be put to use. Thus, the form or extent of completion in fact required by the employer, or which may be acceptable to the employer, will depend, it is suggested, on the nature of the facility, the purpose for which completion is required and the extent of flexibility in terms of objectives that the employer can accommodate.

Conclusion: extensive thought should be given to exactly what is expected, or required of the contractor at the date for completion.

Sectional or phased completion

Employers and contractors often acknowledge that it may not be possible for the contract completion date for the entire project to be brought forward. It is not unusual however for the employer to request that certain areas of the work are handed over early, in order that the employer might have beneficial use of those areas. Such arrangements are common between main contractors and subcontractors. Thus, certain sections of the work would be required to be accelerated and interim target completion dates or milestones set. This may best be illustrated by examples.

> At one extreme will be a project that the employer requires to be fully completed before the facility becomes operational. This most frequently arises where the employer's objective is inflexible or where economic interests are such as to make the employer's position inflexible. Where a pipeline is to be built to carry water from one pumping station to another, clearly the facility will not be completed before the line is built. In this sense, the employer's position is most inflexible. The line will need to be built and fully tested before it is put to use. There is no possibility of putting the pipeline into operation with many defects to be rectified and testing yet to be carried out. Completion of a shopping centre complex may, in theory, be possible by completing some areas first, but economically there may be little interest by

[93] Indeed, Tesco and other leading retailers have detailed discussions with their framework contractors to establish the exact state of completion required.

retailers in taking early occupation. Half finished shopping centres complete with contractors finishing parts of the building do not make good shopping environments. Economically, for the developer, there may be no practical or economical alternative to full completion of the entire centre.

On the other hand are projects where completion in fact required or completion that can be accommodated may be less onerous that completion as originally defined. Thus, where a railway line is being built, it may be acceptable to open part of the line in advance, if served by a group of completed stations. Partial completion in May 1999 of the Jubilee line extension to London's Underground railway provides an example where such a strategy was adopted. To do so may require some reorganisation. Thus, it will not suffice to defer safety installations to a later date.

Take also construction of a football stadium that is to be completed so that a football match can be staged. Completion, as defined under the construction contract, may stipulate completion as being completion of all construction work to the pitch, stands, lighting, ticket gates, fences and other facilities. Provided the pitch is safe, a football match can, however, be staged without all of these facilities. There would be no need for the entire seating capacity to be completed before the first football game can be played, unless the lost revenue was so serious as to make anything less than full completion unviable. It may be essential to achieve completion of areas from which television cameras can operate and broadcasts can be made, but not necessary for hospitality suites or restaurant facilities to be completed for the football match to be played.

From the above, it is concluded that an assessment should be made as to whether completion in phases will assist the employer's objectives. The particular form of completion required by the employer ought to be reflected in the construction contract's completion arrangements: This points to consideration of partial possession, sectional completion, a definition of completion state required (vis-à-vis) defects, commissioning and defects regime.

From the examples above, two preliminary conclusions are apposite. First, it is quite possible that the contractual arrangements for completion are inconsistent with either the employer's particular understanding of completion or inconsistent with the extent of outstanding or defective work that the employer can tolerate to secure the most basic use of his facility. Where the employer expresses an interest in earlier completion, an early analysis should be undertaken of the form of completion in fact required by the employer's business, and the relationship between those requirements and the contractual definition of completion. Second, in so far as the contractor contributes to an analysis as to what is, or is not, achievable, the employer ought to be conscious of changes to the definitions of completion or changes to perceptions or descriptions of work to be done before or after completion. It would not be unheard of for a contractor, contracted to complete all of the works, to confirm that he can 'get the building ready for occupation by the employer' one month earlier and plan to do so on the basis that certain works will be deferred until a later date.

Intermediate completion dates

It is also notable from the case studies that Employers, when considering acceleration proposals, rarely focus on completion per se. Their usual focus is driven by occupational considerations: the need to train staff at the right time, fitting-out needs, and furniture installation. It is for these reasons that he needs to know the state of progress of work to allow advance planning.

Houghton (1992, p.232) notes that the lack of sanction in the standard forms in the event of slow progress by contractors[94] is often overcome in practise by specification of interim key dates or milestones by which defined sections of work must be completed, coupled with financial disincentives for poor performance. The principal difficulty with interim dates, he noted, was identification of enforceable levels of liquidated damages, particularly where the stage was during the project and/or related to integration of different contractors' work. The solutions to this are either that the contractor should not suffer 'damage', but that interim payments are made only in respect of completed subsections, as Houghton suggests (p.237) or that damages in respect of interim dates are unliquidated at, what Hosie (1994, p.218) called, the "multiple interface tier of contracting".

[94] The contractor is only penalised if he actually completes late unless progress is so bad as to merit his removal from site.

Conclusion

Employers might sensibly review two matters before any accelerative actions are instructed.

- The definition of the type of completion sought, to avoid contractors adopting 'artificial' end dates and to ensure that the employer's completion needs are addressed.

- Consider completion of the facility in the context of the business as a whole, addressing whether, and to what extent, completion of some parts of the works might effectively be prioritised over others.

D. 'Reprogramming' techniques and methodologies

A previous chapter explored how contractors use resources, how they progress work and how with increased resources activities can be accelerated. What follows is a brief review, calling upon examples from case studies, of the more common methodologies employed by contractors to accelerate. All fall broadly within what is sometimes referred to as 'reprogramming'. It may be significant to note that some methodologies require assistance or support from the employer whereas others do not.

Increasing resources

This is the most commonly adopted technique chosen to accelerate. Changes in the volume of resources will not generally be evident on the face of programmes. The more likely position is that the main contractor (sometimes in conjunction with key subcontractors) postulate a period in which each activity work might be completed by working over weekends with increased resources, and show the shortened durations on programmes. The impact of greater deployment of resources may simply appear on programmes as shortened durations, or may also appear in shorter lead times between on activity and the next.

Employers perceive this to be the best way to bring out greater progress. Contractors were typically very amenable to increasing resources where there was a direct instruction to accelerate (even where cost issues were left unresolved),[95] where all additional costs were reimbursed,[96] or where the balance of the project was carried out on a reimbursable basis.[97] More caution was evident where no direct instruction to accelerate was evident.

On the whole, the addition of more resources caused unexpected co-ordination issues and, whilst the rate of progress achieved increased, the costs incurred far exceeded expectations, sometimes by a factor or five or more. Hence, deployment of increased resources was a very inefficient and uneconomic use of resources. The reason for this, suggested following the outcomes of work in earlier chapters of this thesis was that progress will tend to increase through addition of scarce resources. The addition of resources otherwise may be largely a waste.

Working Overtime

This is often not directly reflected on programmes. More usual is for a contractor to propose a reduction in durations in the order of 20% in respect of some or all activities over a limited period of time, which he knows can be secured by labour working through weekends.

> On a process plant erection contract in East Anglia, all erection activities fell into delay. The contractor prepared an 'acceleration programme' that showed all remaining work being completed within fifteen rather than eighteen weeks. No particular rescheduling was evident. The contractor had merely adjusted the calendar to record Saturday as a normal working day, thereby reducing time by 16%.[98]

Acceleration by working at weekends carries both expense and risks. First, what begins as 'weekend working', intended to mean working on Saturday only, can turn to working Saturday and Sunday, with addition later of night shifts. Quite apart from efficiency issues, there will also be a need for the entire site setup to be available over these hours, in terms of plant, management and materials. Overtime working can however cause a problem with risk management. Ordinarily a project may proceed on the basis of working five days per week, with Saturday morning available to complete odd jobs. The introduction of weekend working

---

95 Case studies for NEC Birmingham, DeMontfort University, Kings Lynn Power station, New Cement Mills.

96 Galleries Shopping Centre, Kings Lynn power station,

97 See case studies for Sutton Bridge power station and Paper mills in Kemsley.

can reduce that flexibility, and can account for later estimates of time to complete being too short.

Use of alternative designs and methods

The extent to which acceleration can be introduced through use of different methods of working is limited by the available time to alter construction methods. Clearly where the work is undertaken through a complex process that requires scarce and expensive plant there is little prospect of methods being changed. The obvious example here is tunnelling which involves use of specialist machinery that cannot be sourced at short notice.

Dramatic reductions in construction times can be secured through prefabrication off site. With planning, particularly where a series of contracts are executed involving identical components, as occur in shop fitting, installation periods can be reduced from months to days. On conventional projects a change from wet wall construction (blockwork with later plastering) to drywall can achieve time savings. The danger with changes of this nature, mid project, is that so much time is consumed debating and evaluating alternatives that little if any time is saved through the change.

> A project to build a multi-storey car park in UK[99] was delayed during foundation work. In an attempt to accelerate, the construction manager suggested that the project be constructed of precast members in lieu of being cast in-situ. Accordingly the entire superstructure was redesigned, but there were delays in designing, procuring and delivering pre-cast concrete members. It was later realised that had the car park been built to its original in-situ specification, the project might have completed at a lower cost and several months earlier.

Accordingly the opportunities to change designs and methods reduces progressively as the project proceeds. Sufficient time is required to design and procure alternatives for this technique to be of any assistance.

Activity splitting

---

[98] Case Study for Kings Lynn Power Station

[99] This was part of the Galleries project referred to in other respects in the case studies.

On some projects activities are set out in a form that presupposes their completion by only one team or limited by just one key piece of plant. The expression 'activity splitting'[100] refers to either splitting an existing production team to facilitate each team working in separate locations or introduction of a second or further labour gang or team or an additional piece of plant that allows the activity to be progressed in two areas concurrently. Arguably this is not an acceleration methodology per se for it is simply a planning term to reflect introduction of an additional set of activities to track progress of work undertaken by the second team.

Activity splitting as a technique succeeds by accessing and progressing work in what is otherwise free working space. In order for this to happen additional temporary works such as access steps, scaffold or cranage may be required. A difficulty with activity splitting is that it necessarily involves reducing the available working space on site. If one painting team is supplemented by another, the workspace available to either team will halve. This in turn can mean that teams do not secure significant economies of scale in work undertaken and productivity drops as the percentage of non-productive time increases. On the positive side, however, the work completed by the second team doubles workspace available to the succeeding trades.

Whether activity splitting is economical will depend upon the extent to which the completed areas are immediately worked on by succeeding trades: the technique can be wasteful where the succeeding trades are not available to continue work.

> On a shopping centre development[101] a basement was to be formed by installation of a diaphragm wall at ground level and later excavation of the enclosed space. There were delays during installation of the wall, and additional diaphragm wall plant was brought to site to allow two areas to be progress at once. In the event this was expensive and resulted in little benefit to the project. The cost of introducing the second special plant at short notice meant a 30% premium was paid for both plant and staff. Second, the later stages of diaphragm wall work were not critical and subsequent floor slab work was only reliant upon a small section of wall. The acceleration of the end of the diaphragm wall work was largely a wasted expense.

Accordingly activity splitting as a technique is more likely to be successful where resources

[100] See Lock, page 164

[101] Case Study for the Galleries project.

can be introduced at short notice to complete work at the required quality, and where the volume of working space available is significant. This particularly occurs on large projects involving several buildings or facilities or on tower blocks or hotels where many floors or rooms await further work, and where resources can be introduced to progress areas without prejudicing productivity rates due to complaints of lack of space. The greatest issue with activity splitting is the need for the necessary resources to be available to make it possible. Activity splitting will be entirely wasteful as a strategy if other resources are found to be scarce, and thus delaying progress. Thus, the sufficient supply of all resources, including design information and management expertise to supervise and manage works is crucial.

Additional Temporary works

On substantial civil engineering projects the volume of temporary works deployed can be a restraining influence on progress. Additional temporary works can result in different sequences of working, and can facilitate access to other working areas (thus facilitating activity splitting). Thus, temporary glazing or protection over window openings before installation of windows may facilitate internal work commencing in dry conditions.

Changes in sequences can also bring about significant savings in erection time where additional temporary or protection works facilitates weather sensitive work commencing sooner.

> On a project to build a large shopping centre around a central atrium, an early construction method proposed erection of a temporary cover over the atrium to achieve weather protection. This was later abandoned on cost grounds. It was later discovered that without the atrium cover the start of the critical electrical work was two months later than had the cover been provided.[102]

Use of revised completion arrangements

Introduction of Sectional completion is a convenient means of focusing a contractor's resources and attention on an element of the works in order to securing early completion of that section. This only suits where only part of the facility is needed immediately.

---

[102] Case Study for the Galleries Shopping Centre.

> A project to erect an exhibition hall and ancillary accommodation fell into delay. This was particularly problematic as the new hall was due to be used to accommodate part of an annual trade show. The parties arranged that the hall section would be accelerated and was to be completed in isolation of other buildings. Ancillary areas were to follow some time later.

Introduction of sectional completion can, however, cause other difficulties. The plant may now have been designed with a view to sectional completion so fire, alarm, sprinkler, electrical or plumbing installations may have to be modified to accommodate early completion of part of a building or facility.

> During construction of a large petrochemical installation most sections fell into delay. This caused some difficulty for the employer as he was in a position to earn substantial bonuses provided product was processed. The employer agreed with the contractor that just two of fourteen processes would be prioritised thereby allowing production of a base product by the key date. The bonus was secured despite significant delays to other sections of the plant.[103]

Regrettably redefinition of completion may occur unbeknown to the employer. Where a project is in delay, it is not unusual for a contractor to press for certification of completion prematurely.

> An office refurbishment project in central London suffered significant delays. The employer, who had intended relocating all staff from the old office to the new office on the last day of November 1999 was finally allowed to relocate some staff in mid January, and the balance over three successive weekends. This was hugely disrupting to the employer's business. Worse still, much work at the site was outstanding, as completion had been certified on the basis that all fitout of the basement was postponed to a later contract to be completed whilst the building was occupied. This further disrupted the employer's business. The employer, had he known, would have remained at the old address to allow works to finish properly before taking occupation.[104]

Several conclusions can be drawn across each category dealt with above. The first, whilst perhaps obvious, is that if a project is in delay pre-acceleration, that either the existing causes of delay may continue or new causes may arise. Thus, the risk of further delay during the accelerative period needs to be addressed before implementing accelerative measures. Second, as a consequence of the first, is that claims for additional cost may arise post-acceleration.

[103] Case Study for Leuna Refinery

[104] Case Study for Victory House, London.

Whatever the contractual mechanism adopted to implement acceleration, there is a clear need to address this. Third, the extent of exposure to additional costs was repeatedly an area for concern. The range or extent of accelerative measures taken may need to be it defined. Fourth, it is clear that introduction of more resources to a site may give the appearance of more haste, without providing a large difference to the rate of progress achieved. Hence, some consideration needs to be given to the methods that might be employed to reduce delays.

E. *Choice of acceleration methods*

The choice of methods to accelerate work is widely thought to be the contractor's concern. The area in which authors and academics have tended in the past to concentrate was in describing techniques to calculate which activities to accelerate and in what priority, typically called a 'crash cost' algorithm. This is critical path rescheduling method that calculates a shorter period in which the project is to be completed by prioritising activities with the lowest additional acceleration cost. A variant will show the additional costs incurred in bringing forward the remaining construction period by a set number of days.

The basic methodology is set out by, for example, Lock,[105] Pilcher, Cooke & Williams[106] and Mawdelsey et al. The method involves ascertaining for each activity its cost, and also what it would cost were the work undertaken within a stipulated shorter period. The authors anticipate reduction of the project duration by reducing durations of certain activities. Thus, activities with the lowest 'crash' or additional cost would be reduced first and so on thereby ensuring that time was saved with the lowest possible cost consequence. The intention of the algorithms described is to provide a method whereby a contractor might identify which activities might be accelerated, with best effect, at the most economical cost. On the face of it, this is sensible since it is a calculation that optimises time saved against additional cost incurred.

Whilst methodologically sound, there are, however, a number of difficulties with application of the algorithm-based technique proposed.

---

[105] Page 159

[106] Pp 252-269.

1. Viewed pragmatically, this is a calculation that can only be carried out by contractors. It is rare for employers to be provided with a digital copy of the critical path network and employers would have great difficulty estimating the cost of any activity, let alone the shorted duration in which the work might be done or the cost of the work under a shortened duration.

2. That the contractor might want to optimise the cost of accelerating presupposes that contractor is interested in taking the risk on the likely costs involved. This is unrealistic. A more usual reaction is to suggest this is a matter for the employer. If the employer has agreed to compensate the contractor for additional costs incurred in accelerating, the contractor will have no incentive to use the technique. Where no agreement is secured, it is suggested that the contractor will be more interested in securing an extension of time and delay damages rather than risking his own funds on accelerative measures other than low-cost actions.[107] If a project is in delay, contractors are more likely to look at constraints, reasons for delay and acceleration methods that involve no additional cost rather than risking additional cost.

3. Collecting the relevant data to perform the calculation is exceedingly difficult. It is rare for contractors to correlate directly activities, work breakdown and cost breakdown. Estimating the cost of working to shorter durations (the 'crash' cost) would be exceedingly difficult requiring potentially consideration of several resources and effects on other work. So also would estimation of shorter durations be difficult. Subcontractors may not be willing to provide data to support the calculation. The time, effort and experience required to gather this data may not be available. Some authors are of the view that it is only with respect to critical activities that data needs to be collected. If so, the maximum acceleration that will be achieved on the schedule will be the period of float on near critical activities, i.e. those with the lowest total float, so data is also required in respect of all near critical activities.

4. There is no guarantee that the resulting schedule will be achievable. The methodology does not address causes of delay: it may be these that need to be addressed rather than

[107] Or actions for which the contractor accelerates in the hope that the costs incurred can in due course be recovered from others.

notional scheduling hypotheses. It is rare for programmes to include provision for equipment and material lead times, supply of design information or details from third parties, both of which may confound acceleration. Neither is these addressed by the methodology. So too, local regulations, space restraints or non-availability of supporting plant may also confound the acceleration proposed. Acceleration also presupposes that consent is achieved of subcontractors involved, consent which may be unreasonably withheld where it is clear their help is required.

5. Perhaps the greatest difficulty with the methodology is to assume that proposals with respect to subcontract work can be implemented. In fact, the main contractor may have no power to influence at all progress of subcontracted work. This suggests that for the methodology to succeed requires either a firm commitment from subcontractors at the modelling stage (when alternatives are evaluated) or subcontract arrangements that facilitate prediction with certainty of cost and time implications.

6. The rescheduling with the algorithm, whilst nowadays available on modern project planning software, presupposes a sound programme is available that is already available in CPM form and is up to date. Use of preferential logic, as noted early, may confound the analysis undertaken.

It is suggested, in light of the above, that the algorithms, whilst sound, are of little practical use to either a contractor or an employer interested in securing earlier completion. This may also account for the scarcity of reports of use of the algorithm other than for educational or demonstration purposes.

Instead what is required is a methodology for evaluation that identifies with differences in the contractor's interests and employer's interests. Following the issues raised earlier in this and the earlier resource related chapter a methodology is proposed that might better serve the employer's interests:

1. Ascertain relationship between contract work and project completion
2. Establish what work is undertaken by third parties upon which contractor depends?
3. Identify outstanding work

4. Identify critical activities and float on others

5. Identify preferential logic

6. Identify scarce resources

7. Ascertain existing and prospective areas of constraint (especially outstanding design detailing) and resolve actions to remedy or alleviate these.

8. Identify potential reprogramming opportunities

9. Ascertain elasticity of supply of scarce resources and others that might be affected

10. Evaluate risks of further delays etc

11. Undertake cost/value calculations on several bases

12. Review other options: partial completion; reallocation of responsibility, e.g for design assembly

F. Acceleration economics

In any consideration, in advance, of acceleration the financial impact requires some consideration. The academic response is that an algorithmic cost/benefit analysis should be undertaken: the practical view perhaps requires also consideration of risks presently faced and that may be faced in the future.

Value of early completion

In any attempt made to value the benefit to the employer of early completion, it would seem that there are potentially several benefits flowing to the employer. First is the value to the business of the beneficial use to which the facility is put, i.e. the difference between having and not having available the facility. Second, earlier completion may reduce certain risks. These include insurable risks arising from matters outside the project environments and may include non-insurable business risks such as the risk that a competitor may set up first and secure a substantial market share. Third, and perhaps a crucial element in assessing the value to the employer of proposed early completion, is the risk that the early completion might not be achieved. If this risk were high, this would tend to reduce or eliminate the perceived benefits of early completion.

The cost to the employer of securing early completion will be (a) the amount paid to the contractor and (b) amounts paid to other parties to whom he is contracted such as suppliers and the design team consequent upon the agreement made with the contractor.

Likely cost of acceleration

The anticipated acceleration cost is likely to be influenced by a range of factors: the choice of techniques, the extent of acceleration (project wide or limited to parts only of the works) and the contractual arrangements under which the acceleration is carried out.

On what basis might the employer be expected to request a change to the contract completion date? Employers acting rationally would not be expected to agree with a contractor for the completion date to be brought forward unless: (a) the expected cost of so doing was less than the value to the employer of earlier completion; (b) the shortened duration was perceived to be achievable; (c) there was a reasonably strong prospect that the acceleration measures would be successful and achieved within the expected cost; (d) the form of the agreement achieved between the parties reflected the balance of risk of non or only partial achievement of acceleration and (e) the solution was the best after exploration of various completion alternatives involving early completion of parts, but not the whole, of the facility and some special situation arises requiring completion or co-ordination with something else, where retetion of liquidated damages in the event of delay cease to be sufficient.

Implementing and economics

In any proposal for early completion of part or all of the work, the employer can be expected to seek to maintain these contractual interests and to seek to avoid or limit potential liability for failure to fulfil the employer's obligations.

Directed acceleration arises, it is suggested, from a change to the employer's need which requires some or all parts of a project to be completed earlier. In directed acceleration, it is suggested, the employer should seek a position which maximises fulfilment of his needs (this may involve qualitative judgement) and which minimises reduction of his interests and minimises the increase of obligations required under the contract. Thus, it appears that the employer's best interests are served, where work is to be accelerated on a construction project, by securing a new completion date, without changing any other obligations relating to the contractual date for completion, securing from the contractor a definition as to what work is, and is not, intended to be completed, valuing any acceleration on a basis which leaves the contract price intact, ensuring that the employer, his agents, and third party suppliers are all capable of achieving progress required by the contractor's new programme to meet the new end date, and only putting in place such measures where all potential obstacles to the contractors progress, particularly access to works and provision of information are removed. Before any acceleration is directed, it is suggested that the employer sets out, and values both quantitatively and qualitatively the cost to him of altering his position.

Example analysis of employer's position

The project involves fitting out a new retail unit for a leading retailer. The contract price for the work is £300,000. The contract is based on JCT standard terms, unamended. The work is proceeding to progress. The date for Practical Completion is 1 December.

Option 1: Continue with the contract as planned.

Under the standard form the contractor will have 3 months in which to remedy defects, complete de minimis work, etc. Such remedial work would be carried out during standard working hours, and would therefore inevitably interfere with or interrupt trading.

Option 2: Change the definition of completion but maintain completion date as 1 December, as December is the most profitable month of the year.

Nature of completion required: Total completion, with contractors off-site at store opening, to finish 1 December. Such a structure would carry many benefits for the employer: potentially higher turnover and profitability, in that he might immediately trade at full capacity. If store turnover was projected to be £300,000 per month and projected nett profit is 7% annually, then early completion is worth £21,000 per month. Were construction works to be left as under option 1 above, he might only be expected to trade at 30% capacity, earning profits only of, say, £7,000. In this instance early completion in terms in profit that month is worth £14,000. It is worthwhile spending an amount up to that sum to accelerate, but over that sum the cost of accelerating outweighs the advantages.

Taking this example further, assume that completion by 1 December is achieved most easily by agreeing that the cooling system will be balanced in February after the Winter sales period. Immediate work to remedy defects post completion might be carried out from 8pm to 8am, outside trading hours. If this remedial work were carried out over 20 nights, the contractor would incur premium time for contractor for remedial work (say £3,000) and costs for security at night to facilitate weekend/night working post completion (say £1,000). At a total cost to employer of only £4,000 such an option would appear advantageous.

Option 3: As option 2, with completion on 1 November.

Benefit to Business: Additional turnover for 1 month £300,000. Projected nett profit at 7% is £21,000

Direct cost to employer: £ 32,000 made up as follows:

(a) Payments to contractor

Contractor's Pre-completion extra cost: £20,000. Contractor's Post-completion extra costs as option 2: £3,000

(b) Employer's own costs

Site security to maintain access for contractors over 3 months £6,000 Security, to facilitate weekend/night working post completion, as option 2: £1,000

Additional payments to architects (to avoid loss of liquidated damages) for premium time design work and premium time supervision, over 3 months: £2,000

Impact on other interests or obligations: This assesses the increased risk of late completion arising from acceleration. It is assumed that an earlier (pre-acceleration) assessment was of a 20% risk of completion two weeks late at a cost of £10,000 per week. The cost for risk purposes was £4,000 (2 weeks x £10,000 x 20% = £4,000). The revised assessment for an earlier completion date is 40% risk of completion two weeks late due to employer default, at £15,000 per week. The cost for risk purposes is £12,000 (2 weeks x £15,000 x 40% = £12,000). Hence, the risk premium for earlier completion: £8,000

In this example, if cost is the paramount consideration, option 1 appears unfavourable to the employer. Option 2, for the additional cost, brings apparent benefits of potentially equal value with little impact on other project risks. Option 3, after considering both the additional costs sought by the contractor and the increased risk of delay, appears ill-advised.

Hence, the example shows that the optimum solution is largely a function of the employer's own prioritised interests, depending on the value placed by the employer on completion by particular dates. Successful acceleration, for some, will be more an issue of achieving completion by particular dates; for others it will be an issue of budget.

G. *Acceleration and risk*

Under most standard forms, the contractor will be obligated to pay to the employer a sum by way of liquidated damages in the event that completion is not achieved by the contract completion date. The employer's right to withhold liquidated damages is kept alive by provisions facilitating adjustment of the contract completion date where delays are caused or are said to be due to particular events. In the event that the contractor suffers loss or damage due to a specified event or act of the employer or his agents, the contractor, under the standard forms conventionally used in UK, is allowed to recover the loss or damage incurred. It follows that if, during the course of the project a completion date is brought forward, or perhaps new sectional completion dates are specified, the capacity of each party to carry the risk of failing to achieve timely completion ought to be reconsidered.

Conventional thinking suggests that securing implementation of acceleration measures through an arrangement whereby the contractor undertakes to complete the work by a new, earlier, completion date in exchange for an increase in the contract price, leaves the balance of risk between the parties unchanged. This perception doubtless arises because in the event of delay beyond the accelerated completion date the level of liquidated damages is the same as the level for which the contractor originally contracted. It is suggested that the balance of risk may, however, change after a variation to the contract completion date. The change may not be in the employer's favour.

> An erection contractor contracts to erect a steel structure. This he plans to do using just one crane, starting at one end of the structure and moving progressively toward the other. He plans to complete the work in 14 weeks. Liquidated damages run at £10,000 per week. The employer decides, after 8 weeks has elapsed, that the work must be completed within the following 4 weeks, i.e. the contract period would be 12 weeks, not 14. The contractor suggests this can be achieved by introduction of a second crane, at a cost of £6,000 per week. On this basis acceleration is instructed and the contract completion date revised.
>
> Two weeks later, due to a problem on the site that, for the purposes of this example, is the responsibility of the employer, erection work is delayed by one week. It is immediately evident that with the increase of resources to implement acceleration the cost of delay per week rises. Whereas before only one crane and one erection gang were due to be on site, with a running cost of only £6,000 per week, the employer now finds that the contractor's expense incurred due to the delay is significantly greater, as both cranes and erection gangs are delayed. The cost rises to £12,000 for the week's delay. Part of the price paid for acceleration is apparently wasted. Employers ought therefore to recogmise that where acceleration proposals are to be implemented, the cost of delay per week to completion beyond the accelerated date is likely to be higher than would be the case absent the acceleration. The employer faces (a) increased delay costs and (b) wasted costs for accelerating.

It follows from this example that in any consideration as to how the employer's interests might be influenced by acceleration, some analysis should be made of the cost of delay, on the assumption that future delays, for which the employer is responsible, will be incurred.

It is apparent from the case studies that employers, before seeking or instructing acceleration, do not generally consider the potential increase in risk of the project not completing on time, on budget or to the required quality.

So far as time is concerned, a common feature of projects under acceleration is that a larger number of activities are carried out concurrently across a site than would otherwise have been the case. It follows therefore that any event arising during that accelerated period will delay more ongoing activities than would otherwise have been affected had normal progress been maintained. This will directly impact on costs. Thus, a larger number of subcontractors or teams' work will be delayed or disrupted by any event during a period of acceleration, directly increasing losses incurred.[108]

A second feature of acceleration, often undetected by employers, is that acceleration programmes may be prepared with a view to achieving completion by a target date.[109] In so doing, the programme may be conditioned on the need to receive design information by key dates, on there being no variations and on no adverse weather. Hence, it will be prepared on the basis of conditions that would not otherwise have existed absent acceleration. This means that chance of successful completion as predicated by the acceleration programme will, in all probability, be lower.

The other area of risk is with quality of the completed building. This can manifest itself in several ways. First, given the need to resolve design issues to allow work to progress, design of fit-out works may become standardised to achieve timescales, compromising designs previously considered desirable.[110] Second, poor quality of work can arise where the quantity of supervision and inspection carried out falls as a proportion of work undertaken.[111] Third, and most common,[112] is that the standard of work by the accelerated completion will often appear poor: in fact it is just that rectification of defects is deferred until after the accelerated date for 'completion' is said to arise.

From this, it is concluded that introduction of acceleration tends to increase the risk of cost estimates being exceeded and time for completion not being achieved. These risks need to be understood and action taken to prevent their occurrence. Hence the employer and design team

---

108 See Case study for Kings Lynn Power Station and UK paper mills. This was particularly noted in the case study for the Galleries shopping centre when Mechanical and electrical work was sought to be progressed in many areas concurrently.

109 This was noted on the case study for Kings Lynn power station, UK paper mills and New Cement kiln at Rugby.

110 See case study for Victory House, for example, where the reception desk was changed from a bespoke unit to an off-the-shelf desk to ensure that the unit could be delivered on time.

111 See Case study for Barking Reach power station.

112 See Case studies for National Exhibition Centre, Birmingham and Victory House, London.

may need to take positive steps to assist accelerative actions a contractor is to undertake, and those steps may be necessary to achieve the targeted completion date.

H. Summary

The position in which parties find themselves at the pre-acceleration carry a number of common features: a project in delay; little understanding as to the extent or causes of delay; little understanding of the likey cost of accelerative actions; an interest in achieving timely completion by a particular date; little understanding as to how acceleration might be achieved and a limited period in which to evaluate proposals and instruct acceleration. Resolution of areas of uncertaintly should help point toward more effective and targeted accelerative actions.

A large number of techniques are available to accelerate. These are not limited to hiring more resources, but also includes working overtime, activity splitting, additional temporary works, revised completion arrangements. Significantly, some of these techniques require assitance or direct intervention by the employer. Hence, the hypothesis that acceleration is achieved merely by addition of resources is somewhat misguided.

Before acceleration, employers should give some detailed consideration to the position in which they intend to secure through accelerative actions, and should set down and agree actions based upon achieving that objective.

The introduction of acceleration also impacts on risk. The potential increase in exposure might legitimately be reviewed as part of pre-acceleration considerations.

VI. Negotiating Acceleration Agreements.

In this chapter the range of options available to parties entering into acceleration agreements and parties respective interests are set out.

A. The interests to be considered.

The standard forms of contract generally do not contain detailed provisions covering either instructions to accelerate or evaluation of the cost of acceleration. Acceleration provisions merely acknowledge that the parties might agree to change the date for completion and other terms by consent. It is left for the parties to chart their own course in agreeing acceleration-related amendments to the agreement, and/or other provisions at the time they occur. This chapter considers separately the bargaining position of the employer and contractor at the time when the instructions to accelerate, or the agreement to accelerate, crystallises. Like other chapters, little of the material in this chapter has been considered by other authors or commentators. Hence, a large proportion of material in this chapter is developed from first principles.

The parties' respective interests will inevitably inform and shape the terms upon which the parties agree to the acceleration measures. In the absence of agreement of detailed terms, consideration of the contractor's position also gives some insight into the scope of the employer's potential liability for the measures taken.

The contractor's position is considered in two parts. First, a number of observations are drawn from case studies. Second, the range of options available to the contractor to protect is commercial position is reviewed.

B. Contractor's acceleration proposals

It appears from review of the case studies that the process leading to acceleration instructions is somewhat prolonged and often complex. The negotiations were typically characterised by several stages: an initial stage when delay was identified and potential for resolution or acceleration identified; an early call by the employer for an acceleration programme or proposals followed by some discussion between parties over a range of issues; and final choice of strategy with orders for implementation.

Thus, in none of the cases was the contractor simply instructed to accelerate. Some preliminary discussion had ensued first. Usually, the contractor raised the notion of acceleration; or the employer approached the contractor with a simple request – "Can you finish by [date]?" If the project was in delay, contractors were asked to provide or volunteer acceleration proposals. Second, as an observation, the employer invariably found himself in a difficult position. He was dealing with a provider with whom he already had a contract and was seeking to change the conditions under which the facility was to be provided. He had no alternative contractor with whom he could raise the issue: he had no realistic alternative but to use the incumbent contractor. Third, the contractor, mindful of the need to protect his own interest, was inevitably interested in accelerating work, for an acceptable price, particularly if it meant that his project losses could be arrested or profitability on the project could be improved. Fourth, it was noted from the case studies that projects in delay were characterised by poor relationships. This militated against co-operation in agreeing a solution. It was evident from case studies that contractors would offer acceleration proposals as a mechanism to encourage on-going co-operation.[113] By way of an over-arching observation, contractors in delay saw accelerative options, whether suggested by them or by the employer, as an opportunity. It was an opportunity to heal poor relationships, to reduce risk and potentially to put the remaining work on a different commercial footing thus reducing losses or increasing profit.

The contractor's selling strategy in the circumstance typically involved two key stages: (1) The employer was led to believe that the project would finish late and could not, without special measures, finish by the date sought by the employer; and (2) the contractor led the employer to believe that the present state of affairs could be improved, by taking special measures, albeit at a price. The strategy, as is often found in selling strategies, was to explain the ideas first, then the benefits, and only discuss priced if pressed to do so. Often unsaid was that the contractor was to be compensated for extra effort. It follows from what was said earlier with respect to protection of the contractor's interests, that a proposal that released the contractor from existing risks with respect to both price and time for completion and secured

[113] In two case studies, Kings Lynn power station and Kemsley Paper mill, the contractor pressed hard for acceleration on the basis that working relationships would improve if all construction work henceforth was

the balance of the work on a reimbursable footing was likely to be most favourable economically for contractors.

From analysis of the case studies, several points are noted:

- In just one case study (Barber and Hughes) the engineer insisted on assessing the accrued extension of time entitlement as a step in the process.

- Contractors rely upon regular progress reporting mechanisms to show that work in progress is in delay, in advance of acceleration proposals. Rarely, it seems, does demonstration of the exact period that the project is in delay form part of an acceleration proposal[114]. Proposals tend to focus on what can be achieved in future rather than any analysis of the status of progress or how delays to date were incurred.[115]

- The acceleration proposal is usually made in the form of measures to be taken, rather than an objective to be achieved.[116] Where a contractor is asked to 'provide a programme showing how he will recover the delays', that programme is usually conditioned by two points: that all outstanding information will be provided within a specified period and or that no further instructions or variations will be issued.

- The particular measures suggested, and commonly taken include:

    - Extending work hours to include weekends and nights.[117] This can prove very effective for several reasons. It does not require an increase in labour resources – and most operatives look favourably upon opportunities to earn

---

carried out on a reimbursable basis. This argument succeeded on the Kemsley project.

[114] A statement that the project is in delay is a recurring feature of acceleration proposals, but without demonstration of the causes of delay.

[115] See particularly case studies for National Exhibition Centre, Oil Refinery at Leuna, JP Morgan Bank, Paper Mills Kemsley, King's Lynn Power station and Sutton Bridge Power Station

[116] This may reflect the preponderance of employers taking this approach. A notable exception was the case study on JP Morgan bank where there was an agreement to pay a lump sum to achieve a particular date, with details of measures to be taken all left to the works contractor.

[117] This is very popular within the interior fitout contracting industy where pressure to achieve timely completion of retail units and offices is high. Hence, weekend working and night working will often be found just before

overtime payments. Somewhat better is that although a limited number of activities may require additional resources, receipt of authorisation for weekend working can facilitate introduction of additional resources across all site activities. This can help to improve progress on activities in which performance is poor due to matters of the contractor's own making, as well as improving progress on activities delayed by matters for which the employer is responsible;

- Redefinition of completion. This is rarely noted prominently and takes two forms. First, the contractor may suggest that completion of parts of the facility are deferred until after completion or during the commissioning or defects period. This usually applies to areas that are not in the public eye or that are ancillary to day-to-day functionality of the facility. In practise, the employer is often offered partial possession of the site and asked to sign off the entire project as being practically complete. If successful, the contractor may succeed in avoiding liability to liquidated damages. Second, the contractor may offer completion before rectification of defects. Whilst providing the employer with the facility it usually means that defects are rectified in a way that interferes with functioning of the facility, or carried out at night or over weekends, over many months. This can be exceedingly irritating for occupants;[118]

- Reprogramming. The impact of this may potentially be significant. It is not usual, however, for a contractor to adjust certain activities with a view to shortening the time to completion but also make other changes to the programme such as adding to the durations of activities for which inadequate allowance was made at tender stage, or for which subcontractors seek additional time. This is rarely explained to the employer. Another danger for employers is that in resequencing work, the risk of delay in later stages of the project is increased. This is referred to again later.

---

opening of shopping centres and restaurants, but is much less common with public buildings.

[118] See Case studies for National Exhibition Centre, Oil Refinery at Leuna, King's Lynn Power station and Victory House

- Compensation for additional costs incurred is sought in various ways, in part depending upon the way the proposal is structured:

    - One approach is to price a list of intended measures, such as the cost of hiring an additional crane, etc. This is usual where the contractor makes no guarantee as to whether these measures will be successful;[119]

    - Another is the matter is left on the basis that the contractor will seek to recover additional costs incurred;[120]

    - Rarely, and usually only in response to the employer's request, is a lump sum offered.[121]

Thus, although acceleration proposals arose in a wide range of circumstances, the approach taken by contractors in selling their acceleration proposals is surprisingly similar.

From the case studies, two observations can be made:

There is little, if any, evidence of contractors refusing to accelerate: they either pressed for acceleration or voluntarily proceeded whether or acceptable terms were in place. None sought to exploit[122] a monopolistic position by refusing unreasonably to agree to carry out the employer's wishes for accelerative measures to be implemented.[123] The difficulty with this approach, however, is that the price for the work charged at a later date was perceived to be too high. seen as extortionate. Provisions of standard form contracts drafted in later years accordingly required variations to be valued in accordance with schedules of rates. Similarly, it seems, the same principles now apply with implementation of acceleration proposals. Judging by the results of the Commissioners of Military Enquiry, established in 1804 to

---

[119] See Case Studies for Power Station at Kings Lynn, and Castle Hill hospital in Hull

[120] See Case studies for Exhibition halls, DeMontfort, Sutton Bridge Power station, Kings Lynn Power station, Castle Hill Hospital

[121] See Case studies for JP Morgan Bank, London Portman Hotel, Great Pulteney Street.

[122] Hudson suggests, albeit in discussion on the origin of contractual provisions for valuation of variations, that the origins of variation clauses in construction contracts was to prevent the contractor refusing to carry out work before the price of that work or varied work was agreed. This is not borne out by the case studies.

[123] It is notable that this did not succeed at Kings Lynn Power Station.

examine apparent spending irregularities particularly on construction work, (Nisbet, 1993, p.40) it seems contractors have always been happy to carry out work for their masters and to charge for the work later without prior agreement of prices. The obvious issue with this approach is that the risk of the employer losing control is very high.

From observation, it appears that under a typical negotiation, the employer will request acceleration proposals in return for which the contractor proposes a lump sum price to be added to the contract sum and release of liability to liquidated damages for the 'saved' period. The price is usually perceived by the employer to be too high, often with the view that the contractor seeks, through the sum, to make good deficiencies in the tender price. The employer either resolves to pay for limited measures only, or the contractor relents to pressure for costs to be evaluated after the event, leaving the contractor in the uneasy position of doing work and seeking payment later, and the employer in the insecure position of not knowing the likely outcome in terms of either cost or performance. Of equal interest here is the lack of drive, on the part of either party, to ascertain the terms upon which accelerative action were to be followed.

Summary

Acceleration proposals may provide contractors with significant opportunities to correct pricing errors or allowances made at tender stage. Given the monopolistic position in which contractors may find themselves, contractors can be expected to avoid exposing themselves to any further losses.

C. Protecting the Contractor's Contractual Interests

The contractor has certain interests protected under the contract. The first is the opportunity to earn the contract price, to the exclusion of other contractors. A power to order the omission of work has been held not to permit an order to omit the work solely so that it may be given to another contractor who will do it at a lower price.[124] More importantly, this gives the contractor the opportunity to earn a profit.

[124] *Carr* v. *J.A. Berriman Pty Ltd* (1953) 89 CLR 327 (High Ct of Australia)

Second, the contractor has use of the full contract period to complete the work in the sequence of his choice. The contractor will, in the absence of an express provision otherwise, be free to undertake the work in whatever sequence he might choose and is entitled to. As was noted in *Wells* v. *Army & Navy Co-operative Society* (1902) *per* Vaughan Williams L.J. "if one finds the time limited within which the builder is to do the work, that means not only he is to do it in that time, but it means also that he is to have that time within which to do it." It follows from this that the contractor has the freedom to procure and organise resources as he chooses, in a way that he expects will result in the work being carried out at a cost that is lower than the price. He has, therefore, the opportunity to earn a profit. Third, in the event that the works are delayed, the contractor is entitled to relief from liquidated damages in defined circumstances.

Thus, the contractual arrangements provide both security of price and freedom to do the work in any sequence. On the other hand, the contractor will face many potential risks on such a contractual basis;

He has potential exposure to loss should the cost of carrying out the work exceed the contract price. This can arise through initial underestimation of the price, poor performance on the part of labour, subcontractors or the site management team, resource shortages, repeating work that was not carried out to a satisfactory quality.

Work might be completed late. This might arise through under-estimating the original time required to complete the works, poor performance on the part of labour, subcontractors or the site management team, resource shortages, repeating work that was not carried out to a satisfactory quality or unanticipated external events. This may result in exposure to a claim for delay damages from the employer, and similar claims from subcontractors.

If the employer wishes the contractor to complete earlier than the contract completion date, or desires work to be completed in a particular order or in stages, such a request will affect the contractor's interests under the contract in two respects:

(a) in undertaking the work to a different completion date the contractor may be put to additional expense or at least the risk of additional expense than he might not otherwise have incurred;

(b) the contractor may be exposed to additional loss.

It is also helpful to view the project from the contractor's viewpoint in its wider context. Contracting is risky; sometimes one or two troublesome projects can seriously impact on a contractor's cashflow and profitability. The contractor can thus be expected to look for commercial advantages that might become available, either in the form of increasing profit on a project or reducing risk. Risks can be reduced through agreements with subcontractors or by agreeing a relaxation of terms with the employer. Profit can be secured through transferring the pricing basis of the works to be carried out to a more profitable footing, or by recovering losses already incurred.

Should the works be accelerated, if all else were to remain equal the contractor's balance of opportunities would change. He may also be exposed to potential gains, particularly where, by earlier completion, he can earn a bonus and/or put resources to alternative, profitable, use earlier than intended under the contract. Risks, on the other hand, could be expected to increase. Additional costs would probably be incurred through premium payments for labour, materials and plant. Efficiency losses would probably be suffered and subcontractors may extract a premium for their commitment to accelerate. With a shorter time to do the work the risk of delay to the accelerated date for completion may be high.

As noted above, Employers interest is in the date for actual completion. Under most forms of contract if the employer cannot order the contractor to complete the work by either bringing forward the original date for completion or by seeking to have periods of delay reduced, he will require the contractor's consent to do so. In view of the difficulty and expense involved in replacing the contractor were it even contemplated, the employer will effectively be left to negotiate consent with the contractor only. It is only natural to assume that the contractor is most unlikely to provide consent without taking some steps to protect his own position by protecting against any further risks to which he might be exposed. It might also be assumed that the contractor may seek to take advantage of the monopolistic position in which he finds himself, by seeking also to reduce risks to which he might have otherwise been exposed, or further to reduce losses to which he has already been exposed. There are, conceivably, several ways this might be achieved:

(a) By the contract being set aside and all work, whether already carried out or still to be completed, being reimbursed at cost with an allowance for overheads and profit, without liability to damages for failure to complete by the revised contract completion date. This is "the ultimate Holy Grail to which contractors constantly and optimistically aspire".[125] It puts the contractor in a position where all work is being carried out on a basis where he can be sure to recover costs incurred, will be insulated from losses and will be sure to earn a contribution to overheads and a profit. He will essentially be proceeding without any significant financial risk.

The usual argument used by contractors to justify such an approach is that it allows complete freedom to carry out the works as the employer wishes and removes from the contractor the onus of focusing on contractual obligations. It also leaves the contractor free to remodel subcontract arrangements. To use a new expression, some contractors argue that it 'allows the interests of contractor and employer to be aligned'. Where the contractor is asked to provide a schedule of hourly or daily rates for labour and plant resources, the sensible contractor will exclude from those rates certain indirect costs such as site establishment costs, with those to be charged at cost. For the main contractor faced with complex work to undertake without the opportunity to put the work to competitive tender, conversion to working on a reimbursable basis may be the only way to achieve some control of a 'subcontractor's' work.

A change to a cost-plus arrangement can be advantageous to the employer, particularly in small sub-contracts, where the cost of the work bears little relation to the potential losses to which the employer is faced. On the other hand, conversion of all work to be undertaken on a cost-plus fee basis removes incentive to carry out work efficiently but also relieves the contractor of all responsibility with respect to the price for work already carried out. Rarely are situations encountered where this is sensible.[126]

(b) By asking for all *remaining* work to be carried out and reimbursed on a cost plus

[125] Ian Duncan Wallace (1986, p134). See also Jenkins and Ryder (1995, p240)

[126] Note, this was sought at Capper Kings Lynn, but refused.

basis with an allowance for overheads and profit, without any liability for damages for failure to achieve the revised contract completion date. This means that work already carried out would be valued according to the contract's provisions. This can be less than satisfactory for both parties. Where work is in delay, this leaves arguments to be resolved as to what party is responsible for delays to date and over consequential liability to time-related costs. Consequently contractors often seek as part of revised contractual arrangements an indemnity against payment of delay damages in respect of delays earlier in the project. Equally the employer may be asked to settle claims for additional cost made by contractors in respect of earlier project delays.

At least under this arrangement, as the contractor is relieved of his responsibility to keep to his contract price for all outstanding work, there is no room for argument over the adequacy of the price. The potential difficulty for the contractor, under the revised arrangement, is that the employer may be free to award sections of work to other contractors. For the employer, a cost-plus arrangement can have real merit where the employer wishes to exert day-to-day control over the sequence of work;[127]

(c) By asking for all <u>additional</u> expense to which the contractor is put, and <u>additional</u> losses to which he is exposed, as a consequence of his efforts to complete by an earlier date, to be reimbursed. On this basis, the sensibly advised contractor would seek an arrangement that avoided liability for failure to complete by any date before the original completion date.

Such a proposal, apparently attractive, often proves contentious. The sources of contention are many. Employers and contractors often enter into such arrangements with expectations as to total liability differing wildly. Rarely are expectations discussed or expressed at the time. Disputes over quantum quickly emerge once sums invoiced exceed the employer's expectations. Arguments made may include the need for auditing, whether the contractor might recover under the agreement costs incurred unreasonably or due to inefficiency. There may be disputes over the range of costs that can be recovered, involving questions over allocation of staff and head office

---

[127] See Case study for UK Paper project, Kemsley

resources and over allocation of labour generally to the project. Where further delays are incurred, for whatever reason, contractors under 'additional costs' arrangements usually expect reimbursement to cover the further additional expenditure due to delays whereas employers often take a different view.

For the employer, the result of an arrangement to pay additional costs to meet a particular date earlier than the completion date is that sums might be expended that exceed earlier expectations to the extent as to make earlier completion uneconomic.

(d) An alternative is that the 'price' for acceleration is payable as an addition to the contract sum, in which case failure to achieve the requested date results in liability to liquidated damages from the new, earlier, completion date. It is to be expected that contractors, when calculating such a price, would include (i) an allowance for the cost estimated to take the required actions to achieve the new completion date, (ii) a premium to cover overheads and profit, the amount for which may be very substantial given the contractor's monopolistic position and (iii) a substantial allowance to cover the risk that the project's new completion date might not be achieved. This would be an increased allowance to cover the risk of delays that are the contractor's responsibility. Thus, on a project where liquidated and ascertained damages are at £10,000 per week and the contractor is asked to accelerate by one month, the contractor's lump sum quotation for such acceleration may well include up to £40,000, being the potential liability to liquidated damages were the contractor, despite his best efforts, to fail to achieve the target completion date. A contractor in seeking a price for accelerating is unlikely to describe the price in this way to the employer.

The greatest difficulty with this arrangement arises in the event of further delays: contractors argue that acceleration would have been achieved but for the matter causing delay; and the employer says that the contractor's performance was inadequate. The net effect may be to increase substantially the employer's liability to damages for delay when those same costs might have been avoided completely.[128]

---

[128] Case study: London Portman Hotel

(e) Seeking an additional price per week, for each week saved beyond the contract completion date. In order to reflect the cost to the contractor of accelerating, such a price would be expected to differ for each week saved. The cost of saving the first week or two may be modest, but for successive weeks likely to rise incrementally. Such an arrangement provides a direct incentive to the contractor to save time. A difficulty with the use of sliding scale weekly bonuses is that in the event of further delay during the 'acceleration' considerable disputes can be expected to arise over the cause and extent of delays. Where expressed as a bonus, similar comments apply here as to (f) below.

(f) Seeking a lump sum by way of a bonus for achievement of completion by a particular, earlier, completion date (or 'target date'). Provision of a bonus in the event of completion in advance of the contract completion date are usually intended to act as an incentive to the contractor to complete work ahead of schedule. The extent to which the bonus will act as incentive will depend, it is suggested, upon (i) the relationship between the amount of the bonus and the cost which the contractor perceives will be incurred in accelerating to earn the bonus and (ii) the perceived consequences of failure to achieve the target date.

Bonus arrangements, for the contractor, are potentially hazardous. Payment of the bonus is usually conditioned upon achievement of the stipulated objective. This, for the contractor, is an area of risk should the level of bonus be inadequate or achievability at risk of being low. Bonus arrangements dependant upon achievement of one or more completion dates are unlikely to be acceptable to a contractor unless provision is made for extension of the target completion date or dates, under the existing extension of time arrangements or otherwise. Even where extension provisions exist, it is noted that failure to achieve completion, where caused by the employer or his agents, may result in the contractor seeking to recover the amount of the bonus as part of the delay damages, the loss of the bonus being a natural and foreseeable result of the breach, on the basis that an act or omission of the employer or his agent deprived the contractor of the opportunity of earning the bonus.[129]

[129] Examples are evident on some projects: Leuna Project; Bechtel's work on the Jubilee line extension

A view is held by some that the completion date that triggers the bonus should be absolute and not subject to adjustment. This is controversial, potentially resulting in liability under the prevention principle should employer generated delays occur, hence the importance of the management of design imformation during the accelerative stage. It does however have the benefit that focus is on achieving the completion date rather than claims made in efforts to move the target date.

Where a new target completion date is introduced, with a bonus for completion by that date but liability for liquidated damages for completion beyond that date, compensation through the opportunity to earn the bonus alone will not be sufficient to protect the contractor's financial interest, for if, due to his own default, the work is delayed and the bonus is not earned, he will be exposed to liquidated damages earlier than would have been the case. Accordingly contractors can be expected to seek either (i) an amount to compensate them for the perceived increased risk of delay or (ii) an arrangement whereby damages for delay (liquidated or otherwise), would only become recoverable for delays beyond the original completion date. The latter, it seems, is more common.

A contractor asked to make acceleration proposals has three particular contractual interests which he might rely upon opportunistically. Those are, first, that the contractor is, for all practical purposes, in a monopolistic position; second, proposals require for their implementation the agreement of the parties; and third, any such agreement needs to be achieved within a shortening time period. These combine to put the contractor in an extraordinarily strong negotiating position.

By virtue of the agreement to carry out the work, there are three practical problems faced by employers minded to award work to others instead. The contractor is already familiar with the work to be done and is likely to be in a position to carry out the work most expeditiously. Introduction of any other contractor may take considerable time, and omission of significant portions of work is likely to expose the employer to claims or loss of profit. The contractor's position is likely to be strongest where the employer is not in regular contact with other contractors who could replace the contractor at short notice and on favourable terms, where the work is of a specialist nature and/or involves proprietary systems or design contributions from the contractor. Thus, in the contractor/sub-contractor relationship the sub-contractor may not be in such a strong position, and will be weakest if undertaking labour-only works that can easily be sourced elsewhere.

Second, for acceleration to be introduced requires, under most standard forms, a variation to the contract terms, which variation can only be achieved with the contractor's agreement. The contractor has the option of withholding agreement and continuing to complete the work under the original contract conditions. The contractor's position is weakest in this regard where he fears that perception of his unreasonably withholding agreement will damage reputation, or lead to reduction in opportunities for further work.

The contractor's third advantage arises by the very nature of project work. There is a limited time within which work must be undertaken under a contract. Where the employer seeks acceleration proposals, it will be clear that for every day that those proposals are not agreed, or agreement is not found, it will be more difficult, or more expensive, for the contractor to achieve the target completion date required. This provides a powerful incentive to the employer to agree to the contractor's proposals as soon as possible, without undertaking detailed consideration of the proposals. The alternative is to start the process promptly and to look at the matter intensively.

In summary, the contractor has a range of protected contractual interests under the agreement, but also may already have incurred losses or faces the possibility at any time of incurring serious loss. It will be in his best interests to minimise losses and to gain from any acceleration opportunities that may arise. Acceleration requests can provide a rare opportunity during the project to recover earlier losses or to avoid prospective losses. It is for the contractor, through proposals made and through negotiation with the employer, to crystalise the revised contractual terms, if still available.

D. Employer's implementation of acceleration

Having reviewed his own position, and had the benefit of the contractor's proposals, the employer is in a position, if he so choses, to ask the contractor to accelerate. But how should the employer proceed? What strategy might the employer adopt to get the project completed by his chosen date? It is instructive to review first some points arising from case studies.

The case studies show a near universal pattern in the way acceleration came to be implemented. First, the project was noted to be in delay. Next the employer explored with the contractor some proposals to bring the project back on track[130] and, after some discussion, the contractor proceeded with some or all proposed accelerative measures. A striking omission was the absence of discussion or resolution by the employer with respect to the commercial terms on which the accelerative action was to proceed. Clearly, the employer's main interest was to see that accelerative actions were taken, with responsibility for payment being deferred to a later date (in many cases because the employer was not prepared to concede any liability for delays, and hence no liability for acceleration costs, acting as if the employer had persuaded the contractor to accelerate at no charge to the employer, or because the employer believed the cost to accelerate would be minimal). Next, further delays were incurred, leading to changes to the acclerative work being undertaken and a breakdown in communications between parties. Finally, one sees timely completion of a small part of the works and somewhat delayed completion of other sections, and the claims for costs incurred that vastly exceeded levels that the employer understood might arise.

From this several feature of note emerge. First, employers showed a noticable reluctance to address terms or responsibility before instructing or persuading contractors to accelerate. Second, there was a reluctance on the employers part to address employer responsibility issues. Third, the employer's focus was exclusively on the date for completion, not on the form in which completion by that date was required. Fourth, the employers perspective was that accelerative measures were to be taken by the contractor: little or no thought was given the implications for the design team or on removal of obstacles to timely completion that might be employer or design team generated.

From a more detailed analysis of the case studies, it is apparent that the approach taken by employers in addressing their acceleration needs falls into several categories. Common to each is an initial realisation on the employer's behalf that the project is in delay, a complaint that the contractor has insufficient resources on site to carry out the work at the planned rate, and a request from the employer to the contractor for his proposals to recover delays. In response, the contractor provided a revised programme showing earlier completion than otherwise would have been the case. The programme was typically issued under cover of a letter with

130 In some case studies the discussions and proposals were contractor-led: in others they were employer-led.

qualifications. Thereafter contractors introduced acceleration measures under three different circumstances: Supplementary agreement; a direct instruction; or implied request for acceleration.

Supplemental agreement

Acceleration measures were introduced after execution of, or pursuant to, a supplemental agreement. Agreements took different forms. In some, the parties agreed that the contractor was to be reimbursed a fixed sum for achieving a particular objective.[131] Here, there were disputes between parties at a later date over whether the agreed sum should be paid at all, particularly where further delays had been incurred with the result that the objective had not been achieved. The relationship between the bonus for acceleration, and existing contractual provisions dealing with loss and expense and delays was also a notable area of difficulty[132].

In other agreements, the employer agreed to reimburse additional costs incurred through acceleration,[133] or agreed that all remaining work was to be carried out on a reimbursable basis.[134] The outcome is not satisfactory, as exposure to costs is higher than expected, and further delays are incurred. In these cases the principle area of contention, in subsequent months, was that the project was not completed within the hoped for accelerated period in that delays continued to be incurred, and that the costs incurred in accelerating far exceeded expectations. What is clear is that success is most likely where agreements relate to isolated areas of work that can be done in the short period.[135] Where of longer duration and scope the agreement needs provision to deal with the future delays, should they occur, both in the impact on the end date, and acceleration price.

An unrelated issue is that supplemental agreements referring to acceleration are a natural source of interst to auditorss. Labelling and references can affect structure of agreements.

---

[131] See case study for JP Morgan. See also the facts of *John Barker Construction v. London Portman Hotel*; and *Williams & Roffey Brothers v. Nichols*

[132] See particularly the Island Crossing case study.

[133] See case studies for Kings Lynn Power Station and Cement Mills

[134] Case study for UK Paper Mills

[135] See for example the decision to use more scaffolding to a chimney breast at DeMontfort University, a small measure that was successful.

Acceleration pursuant to an oral or written instruction

One of the more commonly noted actions that facilitated introduction of acceleration measures was by means of an instruction from the employer.[136] Typically the employer asked the contractor to take 'special measures' to reduce delay, or the employer consented to the contractor's suggestion that he work to a newly published accelerated programme.

More often than not in the case studies the word "acceleration" was not used, and no direct reference was made to costs or other commercial issues. The silence in this regard seems to have been founded in a view, held by the employer, that the cause of delays (which at this stage of the project remained disputed) might be found to be of the contractor's own making, and consequently it was thought that the employer might not be responsible for any additional costs incurred. Had the employer addressed this directly, the contractor might not have accelerated at all: hence silence on this issue provided a means for the employer, at the time, to nevertheless have the benefit of the accelerative measures. Where challenged on liability, the employer's response was that commercial matters would be dealt with 'under the conditions'.

The incidence and scale of disputes arising under these case studies, after implementing accelerative measures, was significant. In addition to arguments over liability, it was notable that the acceleration objectives were generally not achieved, in that further delays were incurred and exposure to costs was far higher than anticipated, leading to considerable disputes over liability[137] and quantum.[138]

Implied request for acceleration

There is a notable incidence of contractors implementing acceleration without a direct instruction to do so. Either the contractor felt compelled to accelerate following pressure from

[136] See case studies for National Exhibition Centre, DeMontfort University, Barking Reach Power Station, The Galleries – M&E work, and Sutton Bridge Power Station

[137] Arguments in defence were various: the absence of a direct instruction to 'accelerate', the absence of contractual power's to request acceleration under the agreement, and arguments over the cause of earlier delays. Liability issues are addressed later in this thesis

[138] Particularly as to whether costs were 'additional' to those that would otherwise have been incurred or were reasonably incurred.

the employer or the contractor sought to argue that actions taken during the latter stages of the project were acceleration measures. Typically, the contractor put the employer on notice that he was taking special measures to reduce delays, (delays for which he claimed he was not responsible) whilst the employer denied. Employers tended not to comment, hoping presumably to secure the benefit of the acceleration without liability, largely on the basis that the delays were the fault of the contractor in any event[139].

The employer's second option is to assert to the contractor that, under the contract's express provisions, the contractor is obliged to recover delays incurred, and that failure to take all efforts to recover delays will be taken as a breach of those terms. Such an approach not uncommonly is seen where the employer insists that delays to progress are the fault of the contractor, whilst the contractor, at the same time, argues that an extension of time is due. Such a situation suffers a familar difficulty: that it is most unlikely that a definitive consensus view will exist or can be quickly established between the parties as to the cause of delay and as to which party carries responsibility for that delay. Alternatively, the employer may assert that the contractor has a duty to recover delays, but suggests that to the extent that the delays were found to be matters for which an extension of time ought properly to have been awarded compensation for recovery might be due.

Failure to record adequately or at all such 'understandings' between parties are notorious sources of dispute. There may well be significant disputes between the parties at the time over the effect at law of certain contract provisions, as well as over which party caused the delay or delays to occur. More usually, the employer may make such statements to the contractor imploring timely completion in the honest belief that all delays to date are the contractor's fault. The contractor may honestly believe that he is to be compensated for accelerating provided he can show that delays to date are not his fault. These perceptions, or unwillingness to proceed, may dissuade the parties from reducing their 'understanding' into writing.

In what position does this leave the contractor? The success or otherwise of the employer's statements may depend on the likelihood, from the contractor's perception that his employment under the contract will be terminated, or the likelihood of compensation for accelerative actions being secured. Again, as with the other categories, significant debates

[139] See case studies for MAFF Offices, Victory House, Castle Hill, and Great Pulteney St offices

over liability, and quantum are evident from case studies.

A proposed approach to implementation of acceleration

One of the aims of this thesis is to develop a basic model from which acceleration proposals, howsoever arising, might be evaluated. The model would be designed to avoid or reduce the risk of the negative outcomes seen in some many case studies, being reduced risk of further delays to completion, reduced risk of acceleration costs exceeding estimates and reduced risk profile generally. The model is also premised on successful acceleration being a function of the value put by the employer on completion by a particular date, not just acceleration per se, regardless of its cost.

A primary conclusion is that employers should assess the value likely to be secured from accelerated completion before ordering completion. The assessment should consider a range of issues:

- Benefits of early completion[140]. The benefits case should prioritise areas of the project for which early completion will yield greatest value.
- Costs likely to be incurred in accelerating
- Changes to the project risks profile

Thereafter, introduction of acceleration should be value-based, structured so as to support the business case for acceleration. The agreement should be amended so as to introduce controls required or enhanced definition of completion requirements. There are a number of steps the employer can take to better protect his position:

- Assess the nature and form of completion required. Is sectional completion appropriate? If so, consider the implications on design and site progress. Commissioning issues?

---

140 Rarely it seems are these considered directly. A notable exception was found in the Island Crossing Case Study.

- Review and gain a better understanding of the extent of delay to date to each area or section of work. Why? Because if delay to date is understated, that means later activities are probably compressed, increasing the chance that acceleration will not be successful.

- Review and gain a better understanding of the ongoing causes of delay and of matters that might delay future work (especially design team or employer related). Otherwise, the accelerative actions will lead to work being done with more labour and thus very inefficiently.

- Explore beyond the programmes. These do not show design work, lead times, variations, approvals and sign-offs

- Consider a wide range of acceleration solutions, particularly

    - revised methods using new plant;

    - new designs, using new plant;

    - Consideration should be given to greater use of space, particularly site space available out of ordinary working hours.

In the agreement, where possible, the best value is likely to be achieved by agreeing specific measures only. Detailed consideration needs to be given to how future delays are to be dealt with under the agreement.

Information

What information does the employer need to order acceleration? If the work is proceeding to plan, the answer is apparently none. But this accounts only for one side of the bargain. The employer is also bound to pay, either immediately by way of an addition to the price, or later on another basis, the cost of acceleration. The employer, it must be acknowledged, is unlikely, himself, to conduct negotiations over the likely or actual cost of acceleration. Rarely will he have the expertise to understand comprehensively time provisions, characterisation of costs and details of contractor's accounting systems. These are matters that will be dealt with ordinarily by the architect, engineer and/or surveyor, acting as his agents.

It will suffice to note here that there is a range of information that, in attempting to ascertain the actual costs incurred in securing earlier completion, will put those professionals in a stronger position. These include CPM network, actual progress data, and subcontractors cost accounts.

Cost

Employers are concerned, by and large, to minimise the cost of completing the project. Project costs are wide ranging, from site acquisition and engaging professions, to procurement of contractors and paying fees for lawyers, surveyors and funders. The cost can include funding litigation.

Negotiating contracts takes time and therefore costs money.[141] The use of standard form contracts minimises the transaction costs of negotiating contracts,[142] by providing, inter alia, a record of the business deal, a plan for the effect of contingencies by allocating risks, and a management procedures manual.[143]

Acceleration, it is suggested, is action by a contractor in response to a legitimate concern of the employer for the facility to be completed by a date earlier than the contract completion date. That acceleration of all or part of the works is required is not unusual. It is thus noted here in passing that employers would not unreasonably be interested in minimising both the sums payable to the contractor, but also in minimising his transaction costs, the cost of changing position so that acceleration is implemented. He might legitimately expect that the cost of so doing should not involve renegotiating the contract terms, and spending sums on lawyers during performance of the project. It is suggested therefore that employers should be concerned to see that provisions of contracts used for construction of their project would

[141] Beale, Bishop and Furmston, 1995, p908

[142] Hughes and Greenwood, 1996, p203

[143] Op cit, p196

contain provisions that minimise transaction costs.

Employer's position Summary

The decision to accelerate can only be made with some understanding with respect to progress. Employers will limit exposure by

- Evaluating needs pre-contract, and evaluating responses in the event of delay. In the event of delay, Reviewing needs and seeking to achieve needs by minimal changes to project arrangements.

- Employers should review, pre-contract, what mechanisms are in place to measure progress.

In assessing acceleration, employers should focus initially on their own needs, assessing later how a contractor might accommodate those needs. The employers needs to be addressed include the priorities with which different parts of the works need to be completed, the completion dates required of those parts, the likely cost impact. The employer also needs to assess the extent to which the design team can manage the acceleration requirements. Next, the employer should focus on securing a price for accelerating from the contractor that addresses his needs directly, in terms of completion arrangements and cost exposure.

Employers need to address the increased risk of delay and potentially higher time-related costs in the event of delay in the event that accelerated work is sought.

Communication of the employer's wishes

It is suggested that if the employer wishes the contractor to complete earlier than the contract completion date, this might be achieved, or his wishes may be expressed, in several ways:

First, the employer may ask for the contract completion date to be revised, by being brought forward. It appears that this might be achieved in two ways. First, apparently rare, is through use of an express power vested in the architect or employer, under the construction contract, to change the completion date. Such clauses are examined below. The second, it seems, in the absence of such an express power permitting variation of the completion date under the contract is by variation of the contract terms.

Second, the employer might seek to restructure his occupational arrangements. Where it is both possible and is a viable option, he may seek to occupy part of the works earlier than the completion date. Again, although thought unlikely, this may be achieved by variation of the contract terms or rescission of the agreement and a new agreement, which has the effect of either changing existing sectional completion dates or introducing sectional completion dates where they did not exist before.

Third, the employer may ask the contractor to use his best efforts to finish the works before the contract completion date. Expressions in this form are, not surprisingly, fraught with difficulty. The contractor may already be under an express obligation to use his best endeavours to progress the work diligently and thus it is difficult to define what the contractor might do to exceed that obligation.

Practically speaking, it would appear that the contractor would incur no liability for failure to comply with such a request, providing of course he can show that he diligently proceeded with the work. Neither the potential cost incurred or benefit accrued are measurable. Further, the employer may be placed in the unenviable position of being asked to pay a substantial premium, in the form of additional costs said to be incurred as a result of the request, with little foreshortening of the contract period. Expressions of hope from employers, asking contractors to use their best endeavours or best efforts, also leave unclear how, if at all, other contractual obligations are affected.

Fourth, the employer might agree leave the contract conditions untouched and to add that the contractor is to achieve additional sums by way of bonus in the event that certain targets are achieved.

E. Terms of Acceleration Agreements.

By its nature, an agreement between employer and contractor for work to be accelerated is a change to the existing project set-up. Any consideration of change needs to be made in that context.[144]

The employer has a range of protected interests under the agreement

- The contractor will progress the work diligently: This is of some use in reducing the risk that the contractor will complete late having left work until the latest available moment. Coupled with this is termination provisions allowing for introduction of a replacement contractor in specified circumstances.

- to have the specified scope of work completed by the date(s) for completion (subject to extensions granted), to the standard specified;

- The right to deduct liquidated damages for delay

- Access to information. Of significance here is the contractor's programme. Some, but not all, forms also stipulate that the contractor is to provide progress reports or updated programmes.

- Completion for the contract price, subject to adjustments as provided for under the agreement. Coupled with this are the payment provisions that usually provide for payment against work done only.

- Completion to the stipulated or expected standards.

Some other less common time-related provisions in construction contracts include payment of bonuses upon completing certain identifiable work by a particular date, the employer's power to arrange insurance, through the contractor, against loss of liquidated damages, and time of the essence clauses.[145]

The employer's powers (and those of his agents) under the agreement are also limited in

---

[144] Commercial aspects are considered separately in the next chapter.

[145] See *Hughes and Greenwood: ICLR*, re use of standard forms; *Sweet, ICLR 1994*, Standard forms; *Schneider, ICLR,* Drafting and dispute avoidance; See *Smith, ICLR* re Allocation of risk; See *Megens, ICLR* re risk allocation; *Jones: ICLR* risk allocation; *No dispute* Report; and Policy on time provisions/their importance: *Uff, Const LJ*

several important respects. In the absence of specified sectional completion dates, the employer will have no power to direct parts of the work to be completed in advance of the date for completion. He also will have no power to direct that work be completed by a date earlier than the date for completion. Nor can Extension of Time awards be reversed or reduced. Should the employer seek either of these, the contractor's consent will be required. The employer generally has no power, in the absence of express provisions, to secure from the contractor certain information (e.g. progress information, CPM, programmes, or details of subcontractor arrangements. Thus care needs to be taken to define such requirements in contract documents, to describe provision of that information as part of the 'Works' to be performed.

Difficulties with acceleration agreements, evident from the case studies where employers had sought acceleration, were reviewed earlier in this chapter. Problems found were: confusion over liability for delays incurred during the acceleration phase; lump sums which left confusion over earlier/later causes of delay; and poor documentation of contractor's qualifications to proposals. The other issue noted was poor consideration given in advance to the form and extent of completion required by the accelerated date.

It was noted, during research, a dearth of acceleration agreement proformas[146]. There are fewer still commentaries on matters that might be considered by parties in considering agreements. The proformas found make provision for a change to the date for completion and cost of accelerating. They do not deal with sectional completion, or with definition of completion.

Based on the material in this chapter, a checklist of matters that might usefully be addressed by an employer in addressing acceleration needs with a contractor is set out in Appendix E.

F. Summary of findings

It was clear from case studies that contractors in delay tended to see accelerative options,

[146] The Acceleration agreement used for the Island Crossing case study was detailed and dealt with a wide range of issues. It was bespoke, and forms a model template found first in Barber & Hughes *Building and Civil Engineering Claims in Perspective* (3rd Edition) Longman Scientific and Technical, and also published with permission in Building Contract Disputes: Practice Precedents at 15-175 (looseleaf by Sweet & Maxwell, London)

whether suggested by them or by the employer, as an opportunity. It was an opportunity to heal poor relationships, to reduce risk and potentially to put the remaining work on a different commercial footing thus reducing losses or increasing profit.

Much of this chapter was concerned with options available to parties when addressing whether to undertake acceleration. A key point noted is that both parties potentially have available a wide range of commercial bases upon which an agreement to accelerate might be founded, ranging from an agreement for payment of a lump sum conditional only on achieving completion by a noted date; to taking acceleration measures with all work being carried out on a reimbursable basis.

A second finding in this chapter is that consideration of risk should play a key part in choice of bases to accelerate, with emphasis on risk of subsequent delays to performance.

A third finding is that a range of issues should be addressed as part of an agreement to accelerate. In addition to basis of payment in exchange for taking accelerative action is responsibility for past, present and future delays, treatment of existing conditions, treatment of liquidated damages and the need potentially to redefine completion in terms of work to be achieved and stages in which completion is achieved.

VII. Directed or Agreed Acceleration

This chapter reviews the various mechanisms through which parties might agree to carry out accelerative actions on a consensual basis, whether through provisions in standard forms or otherwise. Matters that might be covered under bespoke agreements are also considered.

A. Directed Acceleration generally

Acceleration falls conveniently into two categories. The first category is acceleration undertaken pursuant to a direct instruction or agreement between the parties that acceleration is required in exchange for some reward, whether reibursement of additional costs[147] incurred, a success fee, release from obligations or otherwise. This chapter deals with that category. This may arise in one of several ways:

- that completion is required earlier than the contracted date for completion;
- that completion is required earlier than would otherwise have been the case had delays not occurred, or
- that the expected date for completion will not move despite instruction of additional or varied work.

Regardless of which form it takes, acceleration introduced as a consequence of an instruction from the architect, engineer or employer where the obligation to pay is agreed will be referred to here as 'directed acceleration' using the conventional US terminology. Disputes in this category tend to be limited to quantum.

The second category, with which the next chapter is concerned, is those cases where one party accelerates and the other denies all liability to additional costs, on the basis that the acceleration was not ordered or was not required. Hence, under the second category, the

[147] The identification and calculation of 'additional' costs is dealt with in Chapter IV and generally means costs or expense over and above what would otherwise have been incurred but for the accelerative actions taken.

liability to pay and quantum are typically contested. Cases where the contractor without the employer's express or implied agreement implements acceleration measures will be termed 'voluntary acceleration'. The position of "constructive acceleration" as developed under US Federal jurisdictions and the relevance, if any, of this doctrine under the English legal system is considered later in the next chapter.

A number of issues fall to be considered here. First is the means by which acceleration might be directed. Most standard forms of contract do not contain provisions expressly empowering the employer, architect or engineer to order acceleration under the contract; or where they do so their adequacy is questionable. Second the direction to accelerate may be made following delays to progress, raising liability issues. Third, even if asked to accelerate the contractor might incur further delays, the responsibility for which may also be contested.

B. Acceleration provisions in the standard forms.

Time-related provisions of the standard forms, both in US and UK, have been slow to evolve. The time-related provisions in the JCT 1998 standard form reflect in structure and are largely similar to those found in RIBA forms drafted 50 years ago. The JCT standard form 1998 edition, like many others, makes no reference to acceleration. In US, Sweet notes in his commentary on the AIA's forms the lack of provisions with respect to progress and schedules, on the basis that these are matters left entirely for contractors to manage.[148] He notes that this is also due to architects' reluctance to comment on contractors' programmes.

Several recent developments have encouraged acceleration provisions to be drafted. First, businesses do, at times, need to secure the facility sooner than the contract date for completion, or are not in a position to tolerate delays to completion. This applies particularly to projects developed specifically for events that could not be postponed. Where facilities are under construction for events such as major sporting or ceremonial events, time for performance might be sacrosanct, and that the contractor was not to be allowed additional time. Second, as contractors have improved planning and management techniques, so also increase the chance of successful deployed of acceleration measures has increased. Third, new forms of contract have been developed, encouraging innovation in drafting.

[148] Sweet, 1992, page 486

Acceleration provisions as drafted tend to take one of three forms: as part of the variation clause; as a part of the extension of time provisions; and an enabling provision allowing incorporation of a supplemental agreement. The variation and supplemental agreement provisions are dealt with further below.

Variation clauses

The origin of variation clauses in standard forms was to empower the architect or engineer to vary the work which is to be carried out under the contract without the need for the contractor's prior agreement in each instance. The absence of a variation clause potentially gave to the contractor a power of veto over every change, agreeing only to those changes on terms with which he was in agreement. Beale (1998) notes that standard forms used in UK do not cover "the vexed question of variations to the terms of the contract... as opposed to variations in the work".

Variation clauses have two functions. One function is to authorise the architect to vary the works. The second is to expressly limit the range of issues or matters over which the architect can legislate. In the absence of a variation provision a contractor will not be under any obligation to accede to a variation request. Dorter[149] notes that even where there is an authority to vary contained in the contract, an insistence by the principal that the contractor observe an order or direction which is not within the scope of that authority will, in the circumstances of the case, constitute a repudiation of the contract.[150] Hence, the employer may have no power under the agreement to issue an order to the contractor for accelerative actions to be taken but might request acceleration outside of the agreement.

There are a number of reasons why variation provisions are limited to variation of the works only. First, valuation of changes to contract terms (such as the date for completion) cannot readily be carried out from agreed rates and prices, thereby giving rise to contentious valuation of the costs incurred. Second, and in any event, it may be that the change sought cannot be achieved.

---

[149] See Dorter (1998 p289)

[150] Citing *Wegan Constructions Proprietary Limited v. Wodonga Sewege Authority* [1978] V.R. 67

The standard variation clause[151] contains a number of notable features: The power to vary is unilateral for the reasons noted above; the power is limited to varying the works; there may be further limits on extent of variations, such as preventing omission of more than 30% of the works; there is usually a mechanism for valuation of the variation; and there may additionally be a power to accept quotations. Provisions of this nature have been carefully developed over time between employers and contractors. On the one hand such clauses provide the employer with a power to vary the works unilaterally at short notice, at a price that might be calculated later by reference to rates and prices. For the contractor, they limit the matters that might be varied without his consent, but provide a mechanism for valuation and payment. Limited attempts have been made by draftsmen to draft variation clauses on a wider basis so as to include provisions to vary contract terms such as the contract completion date.

For an illustration of these principles, the case study for King's Lynn Power station is instructive. This was a project involving erection of a steel frame in UK the contract for steelwork erection, contained provisions as follows:

> 16 Changes
>
> 16.1 Buyer reserves the right at any time to make changes to the Purchase Order. If such changes cause an increase or decrease in Seller's cost or an alteration in the delivery time an equitable adjustment shall be mutually agreed upon.
>
> 16.2 Any claim by Seller for adjustment must be submitted in writing for approval within ten (10) calendar days from the date on which such change was advised. Any claim not asserted in writing within the said ten days period shall not be admissible.

The Buyer in this case was the employer. These clauses formed part of the employer's standard 'Purchase Terms', which had clearly been drafted for procurement of goods but was being used to procure the services of a steelwork erection contractor, and accompanied a Purchase Order which set out the work to be carried out, the purchase order price, and various provisions with respect to insurance, and the like. The Purchase Order contained both start and finish dates. These terms, however, were the source of disputes between the employer and erection contractor: the employer thought it empowered changes to the date for delivery, whereas the contractor was of the view that only changes to quality and specification of goods to be supplied could be instructed. Nor was the employer expecting any claims for additional costs. The contractor argued that under clause 16.1, since the clause referred to changes to

[151] See clause 13 of the JCT standard form, for example

matters within the Purchase Order, the employer might, if he so desired, change the contract completion date. It will suffice to note here that there were in that case significant differences of opinion between employer and contractor as to what the clause meant, its ambit, and its relationship with other provisions and whether it was merely to be read as limited to work to be performed under the contract. In this case the contractor argued, much to the employer's surprise that comments at meetings or comments in letters might have become the foundation for substantial claims for additional cost. This example does, nevertheless, help illustrate why widely drafted variation provisions facilitating unilateral adjustment of the contract completion date which has the effect of shortening the contract period, requiring accelerative action by the contractor, may be undesirable from both contractor's and employer's perspective.

Singapore's Public Sector Standard Conditions of Contract for Construction Works 1995[152] is, however, unusual in that it provides a variation clause as follows:

> "14.1 **Contractor to complete on Time**
>
> The contractor shall complete the works and any phase or part of the Works within the Time or Times for Completion…
>
> "19.1 **Variations**
>
> The term "variation" shall mean any change in the original Contract intention as deducted from the Contract as a whole describing or defining the Works to be carried out and shall include but is not restricted to:
> (a) …
> (f) a requirement to complete the Works or any phase or part by a date earlier than the relevant Time for Completion.
> For the avoidance of doubt the term "variation" shall include any changes as aforesaid which may be designed to alter the use to which the Works will be put, but shall exclude any instruction (which would otherwise be a variation) which has arisen due to or is necessitated by or is intended to cure any default of or breach of contract by the contractor.

The clause is unusual in that it leaves the Time for Completion unamended and makes no provision for it being reset at a date earlier than the Time for Completion. The Extension of Time clause 14.2 only allows for extensions. The provisions for valuation of variations make no attempt to distinguish between variations under (f) and variations to the Works. Crucially,

[152] See Leong and Chan (1998) pp45-77

there is no requirement for the value of the variation to be agreed before work proceeds.

There are, it is suggested, several reasons why variation clauses do not provide an appropriate means for directing acceleration. In UK and in commonwealth countries, there is a tradition, followed through the standard forms, that variations are predominantly priced on the basis of value by reference to either a priced bill of quantities or priced schedule of rates. Where rates are not applicable, rates are adjusted, or work, as a last resort is valued on the basis of actual cost incurred. There is no requirement for the parties' agreement to value before the work is carried out.

Where it is expressly provided that agreement on the value of variations is required prior to execution of, or payment for, varied work, two difficulties often emerge, failure to agree on price results in an impasse, and delay to the works, and contractors, where they do proceed with the work, argue that, absent express agreement, agreement that work would be paid for in any event is implied. Were the architect, engineer or employer to instruct a variation to the contract completion date, by bringing the date forward, whereby the contractor had to accelerate to achieve the new completion date, it is not clear how such a variation would be valued. Even if the value were to be achieved on the basis of the loss and expense incurred by the contractor, it may be that the new, earlier, completion date cannot be achieved. This would raise further questions as to the extent that, or whether at all, liquidated damages might be recovered by the contractor for failure to achieve the new completion date. Indeed, it might be argued that the liquidated damages might form part of the loss or expense incurred by the contractor. In any event, the employer would be in the position of seeking completion by an earlier date without a clear idea of that objective's achievability or likely cost. This is a position that is very favourable to a contractor, and not at all favourable to the employer. Indeed, it appears the ambit of variation clauses is expressly limited in standard forms in order to limit the range of matters over which the architect has authority to vary.

The provisions of the PSSCOC do not deal with these difficulties but is nevertheless noteworthy in one respect. It acknowledges that owners may wish for parts or the whole of the works to be completed early, and provides a framework for such instructions to be given by the supervising officer, for the contractor to provide a quotation for the 'variation' and in the event the parties fail to agree, provides for the work to be valued 'at cost'. Further provisions allow for recovery of loss and expense incurred as a result of variations. These provisions seem to follow, with some striking similarities, agreements that parties find themselves making on projects undertaken on terms that do not refer to acceleration. Given the historical development of standard forms, whereby forms are amended to take account of recurring business practices, similar provisions in standard forms worldwide can be expected in the future.

It is also notable that the JCT standard form contains, indirectly, a provision for adjustment of the date for completion within the variation clause. Under clause 13A the contractor can prepare the valuation of variations. The quotation is to set out the value of adjustment to the contract sum, adjustment to the time required for completion of the works, loss and expense and if sought an explanation of the methods and resources to be used in carrying out the variation. Adjustment of time includes an earlier completion date from that stated in the appendix. The definition of the term 'variation' includes "the imposition by the Employer of obligations or restrictions in regard to...the execution or completion of the work in any specific order". Pickavance's view is that this provides a collateral agreement for acceleration. [153] Thus, the contractor would prepare a quotation for acceleration that, if accepted, would be a variation under the agreement. If, as suggested, this is an available mechanism, it would seem that the parties are limited to agreeing the time and cost aspects: it does not, however, appear to facilitate agreement of any other terms, particular ones that might vary terms of the agreement other than dates.

Separate acceleration provisions

The second means by which, conceivably, provision may be made for acceleration is through a clause facilitating, with the contractor's consent, adjustment of the contract completion date, with a corresponding adjustment to the contract price. Some, but not all, standard form construction contracts contain an express provisions drafted along these lines. *Hudson* notes that an express contractual power to accelerate or advance the date for completion (that is, give an "acceleration order") is virtually unknown for the very practical reason that, on the assumption that the contract completion date and the project have been planned on the basis of that use of an optimal plant and labour force, acceleration in many cases will be impractical if

[153] 2nd Edition, page 331

not impossible, or only at a wholly uneconomical cost, perhaps beyond the resources of the contractor.[154] This statement is not fully explained and is potentially misleading. An alternative articulation may be that that contractors will be reluctant to accept conditions in which the architect, engineer or employer have open-ended powers to order acceleration in circumstances where liability to pay may be unclear. In addition, employers may be reluctant to see provisions in an agreement facilitating orders for acceleration to be given for fear that their exposure may be, as *Hudson* says, uneconomical. The comments relating to optimal use of plant and other resources and impracticality might otherwise be somewhat overstated[155].

In 1982 the UK-based Architects and Consultants Association (ACA) prepared a standard form of contract that gave strong powers to the Architect.[156] It was not favoured by contractors and has now fallen out of regular use. It contained the following clause 11.8:

> 11.8 Acceleration and postponement
> The Architect may at any time, but not unreasonably, issue an instruction to the Contractor to bring forward or postpone the dates shown on the Time Schedule for the Taking-Over of the Works, any Section or any part of the Works and the Contractor shall immediately take such measures as are necessary to comply with such instruction and provisions of Clause 11.3 shall apply to the adjusted date. The Architect shall ascertain and certify a fair and reasonable adjustment (if appropriate) to the Contract Sum in respect of compliance by the Contractor with such instruction and any damage, loss and/or expense suffered or incurred by the Contractor arising out of or in connection with such instruction and any damage, loss and/or expense suffered or incurred by the Contractor arising out of or in connection with it: Provided that if prior to giving any such instruction the Architect requires the Contractor to give an estimate of the Adjustment to the Contract Sum, the provisions of Clause 17 (other than the provisions relating to extensions of time therein contained) shall apply as if an instruction given under this Clause 11.8 were included in Clause 17.1"

Clause 11.3 was a damages for delay clause. Clause 17 dealt with the valuation of Architect's instructions; Clause 17.1 contained the following:

> "... the contractor shall...furnish the Architect within 10 working days of receipt of the instruction with estimates of: (a) the value of the adjustment

154 *Hudson*, 11th Edition, 7.050.

155 See Chapter 4 above, where it was noted that acceleration may even bring about savings rather than additional cost.

156 The extent of use of this form appears to be comparatively low: See RICS Contracts In Use survey

> (providing him with all necessary supporting calculations by reference to the Schedule of rates or otherwise); and (b) the length of any extension of time to which he may be entitled under clause 11.5; and (c) the amount of any damage, loss and/or expense which may be suffered or incurred by him arising out of or in connection with such instruction." Clause 17.2 concerns Agreement of Contractor's Estimates and Clause 17.3 concerns Failure to agree Contractor's estimates. Under this, "If agreement cannot be reached within 5 working days of receipt by the Architect of the Contractor's estimates on all or any of the matters set out in them, then (a) the Architect may nevertheless instruct the Contractor to comply with the instruction in which case the provisions of clause 17.5 shall apply as if the Architect had dispensed with the Contractor's obligation under Clause 17.1; or (b) the Architect may instruct the Contractor not to comply with the instruction; or the Architect may refer the Contractor's estimates to the Adjudicator for his decision."

Clause 17.5 deals with the method of arriving at a valuation if no agreement of estimates is reached:

> "The Architect may, by notice to the Contractor before or after the issue of any instruction, dispense with the contractor's obligation under clause 17.1, in which case the Architect shall, within a reasonable time after the issue of such instruction, ascertain and certify a fair and reasonable adjustment to the Contract sum based on (where appropriate) the Schedule of Rates in respect of compliance by the contractor with such instruction and any damage, loss and/or expense suffered or incurred by the Contractor arising out of or in connection with it and a fair and reasonable extension of time shall be granted under clause 11.6."

These clauses were unique: nothing similar was available in other forms, nor has anything similar been drafted since in other leading forms. Nevertheless these provisions are of interest for their attempt to empower the architect to order acceleration unilaterally. From the contractor's perspective, clause 17.5 was most undesirable. The contractor might, or would probably, find himself being instructed to accelerate without any idea how long it might be before the cost of doing so might be recovered. Valuation ascertained by the architect is, it is suggested, likely to be a highly contentious matter. The wording of clause 11.8, which confirms that an adjustment to the contract sum is only to be made 'if appropriate', supports this suggestion.

The ICE Standard forms

These provide a useful illustration as to how acceleration provisions have gradually entered the standard forms. Since the Fourth Edition, published in 1955, progress related provisions have been found in clause 46. In the Fourth Edition clause 46 read

> "...Should the rate of progress of the Works or any part thereof be at any time in the opinion of the engineer too slow to ensure the completion of the Works by the prescribed time or extended time for completion the engineer shall so notify the contractor in writing and the Contract shall thereupon take such steps as the Contractor may think necessary and the engineer may approve to expedite progress so as to complete the Works by the prescribed time or extended Time For Completion. ...".

This clause was limited to those cases where the contractor was in culpable delay. The Fifth Edition had a similar provision, and added "The Contractor shall not be entitled to any additional payment for taking such steps". Clearly this clause did not empower the engineer to issue instructions to accelerate or to certify payment for taking accelerative actions.

The 6th edition contained, at clause 46(3), an entirely new sub-clause headed "Provision for Accelerated Completion" as follows:

> "If the contractor is requested by the Employer or the Engineer to complete the Works or any section within a revised time being less than the time or extended Time for Completion prescribed by Clauses 43 and 44 as appropriate and the Contractor agrees so to do then any special terms and conditions of payment shall be agreed between the Contractor and the Employer before any such action is taken."

This clause has a twofold purpose: first to remind parties that an agreement on "any special terms and conditions of payment" should be agreed before accelerative action is taken. Second, it attempts to incorporate any acceleration agreement reached within the original agreement, thus ensuring that related provisions (such as the dispute resolution clause or defects provisions) apply consistently to all. The clause, seemingly introduced in order to reflect the increasing frequency with which acceleration agreements were being drafted, is retained unamended in the 7th Edition of the form. It allows the parties to agree terms without necessarily requiring a detailed deed of variation to the agreement.

FIDIC forms

Before 1999, the FIDIC conditions with respect to progress replicated those in clause 46 of the ICE Conditions. There was no separate provision with respect to acceleration. This was changed in the new FIDIC Conditions for Construction (the Red Book), the first edition of which was published in 1999, which takes a cautious approach to acceleration. Clause 13.2 invites the contractor, at any time, to submit to the Engineer a written proposal for, amongst other things, bringing about an accelerated completion. He must set out a description of the proposed work to be performed and a programme for its execution, a proposal for modifications to the programme and to the date for completion and the proposed price, much in the same way as provided by NEC. Like the ICE clause 46(3), the FIDIC clause is facilitative. A potential difficulty with the FIDIC clause is that it presupposes adjustment of the date for completion and price only. No mention is made of section completion, bonuses for early completion or liability for failure to achieve the early completion date, for example.

GC/Works/1: Edition 3

The use of facilitative clauses, that balance the interests of both contractor and employer, is also apparent in the latest edition of the standard form drafted primarily for use by UK Government departments. This edition contains a new provision at clause 38:

> (1) If the Authority wishes to achieve completion of the Works or any relevant Section before the Date or Dates for Completion, he shall direct the Contractor to submit to him within the period specified in the direction: (a) the Contractor's priced proposals for achieving the accelerated completion date, together with any consequential amendments to the Programme, or (b) the Contractor's explanation why he is unable to achieve the accelerated completion date.
> (2) If the Authority accepts the Contractor's proposals he shall specify: (a) the accelerated Date for Completion of the Works and any relevant Section, (b) the amendments to the Programme, including any relevant critical paths and any supporting documentation, (c) the amount by which the Contract Sum shall be adjusted, (d) a revised Stage Payment Chart or Charts, (e) any other relevant amendment to the Contract which has been agreed with the Contractor.
> (3) The Contractor may at any time submit to the Authority proposals for completing the Works or any relevant Section, before the Date or Dates for Completion. The Authority undertakes to consider any such proposals and if he accepts them to take action as in paragraph (2).

These provisions anticipate that the Authority may wish to finish earlier than the contract completion date even if the project is proceeding to plan, and are price based, that is to say, the value of the accelerative action is the price agreed with the contractor. No provision is made for acceleration absent agreement on the price. Thus, this presents a provision that is likely to be acceptable to a contractor, particularly as it expressly acknowledges that the contractor may volunteer proposals for early completion. Further, the clause anticipates that the parties may agree to vary matters other than the contract completion date and the contract price. The particular mechanism by which the acceleration proposal is incorporated into the contract is somewhat novel, for it involves the Authority "specifying" the agreed revisions. This, it seems, is intended to avoid the need for a separate agreement to be drafted.

MF/1

This standard form does not contain acceleration provisions. A very different approach to acceleration was taken by a French-based engineering group, set out in a bespoke amendment drafted to the MF/1 form, for a pipework subcontract on a power station contract.[157] The relevant parts of the amendment read as follows:

> 33.4 Reduction of Programme
> The Purchaser shall have the power by notice to the contractor from time to time during the execution of the Contract to instruct the Contractor to accelerate the completion of an activity or a series of activities and the Contractor shall implement such acceleration and be bound by these conditions in so doing.
>
> 33.5 Valuation of reduction of Programme.
> The amount to be added to the Contract Price in respect of acceleration instructed by the Purchaser shall be determined in accordance with the following procedure:
>
> When the duration of an activity is reduced by a maximum percentage of … %, the value of the activity shall be increased by a maximum percentage of …%. If the duration of an activity is reduced by less than …% the value of the activity shall be adjusted in direct proportion. For the purposes of calculating the addition to the Contract Price due to the increase in the value of the activity the Purchaser shall determine the value of the activity and the Contractor shall make available all such information necessary.
>
> The Contract Price shall only be adjusted by the percentage addition proportional to the reduction in the activity duration upon achievement of the revised completion date for the activity. Should the contractor fail to meet the revised completion date for the activity the addition to the contract price will be calculated pro-rata to the actual reduction in the duration of the activity excepting that the failure is due to acts or omissions of the

[157] Case study for Barking Reach Power Station.

purchaser.

This provision differs from provisions found in other forms in several respects[158]. None of the standard forms attempt either a formula approach to valuation of accelerative action, seek to value acceleration based on results alone, or anticipate the engineer or owner requiring particular activities or a limited number of activities to be accelerated. All of these aims were attempted in this bespoke amendment. In practice, the provision proved unworkable. First, the clauses does not differentiate between the different motives for which acceleration might be requested, one being to seek work proceeding to plan to finish earlier, the other being for work in delay to recover delays. Understandably, the employer was reluctant to pay for accelerative work to recover work in delay, as all delays were perceived to be the contractors' fault and responsibility. Second, whether or not the employer requested acceleration on several occasions was a matter in issue. The clause only provided that the employer "by notice" instruct that acceleration be introduced. It was not difficult for the contractor to construe comments made at meetings, and recorded in minutes, as being a valid instruction. Third, the valuation provisions proved unworkable. It was not clear whether pro-rata proportionality was to apply where, during the course of accelerating, the target date could not be achieved due to matters that were the fault of the employer.

Two further difficulties were found with this provision. It required the engineer to identify particular activities to be accelerated. In practice, the employer regarded all contents of the contractor's programme as being a matter for the contractor and instead suggested areas of work to be accelerated without reference to the programme. Disputes arose as to what work was to be accelerated. In any event, it appears that the relevant activities would have been a matter of some debate, as the contractor was making frequent changes to the programme.

The greater difficulty with the clause was that it dealt with compensation for acceleration to specified activities only, whereas, in some instances, accelerative actions could not be achieved without other activities being accelerated. It seems that the attempt to provide for acceleration of particular activities failed to recognise the logical relationship and shared resource constraints between those and other activities. It is of little value to the employer for four activities to be accelerated if resources are being diverted from 100 other activities which

[158] But see the Canadian General Conditions, clause 36.5 where similar provisions are to be found referring to compensation for accelerated parts of the works.

delays completion.

NEC ECC form, 2nd Edition

The time and cost provisions under the NEC form are not complex, but unlike those found in other forms, and contains two mechanisms through which acceleration might be sought. The first mechanism is through direct provision whereby the project manager may instruct the contractor to submit a quotation for acceleration to achieve Completion before the Completion date. A quotation for acceleration comprises proposed changes to the prices and the Completion date and a revised programme. Under clause 36.2, the contractor submits a quotation or gives his reasons for not doing so within the period for reply. If the project manager accepts a quotation for acceleration, he changes the completion date and the prices accordingly and accepts the revised programme.

The second mechanism is somewhat more complex. In the event of a compensation event, whether a variation to the works, delaying event or whatever, the project manager seeks from the contractor a quotation for the time and cost consequences. Thus, the form has no separate extension of time provisions, for these are integrated within the compensation event provisions. Crucially when seeking a quotation the project manager is empowed to state assumptions upon which the quotation is to be provided, and those assumptions might be, for example, that the date for completion is not to be adjusted. Hence, the contractor would price for accelerating or taking whatever action may be required to avoid a delay to completion. This allows acceleration to be incorporated by agreement with even requiring a direct reference to the term acceleration.

Concluding comments on forms

In summary of the above, provision is not generally made in standard forms for direction of acceleration. Neither architect, nor engineer, nor employer is empowered to issue orders to accelerate. The contractor's consent to accelerate therefore will be required to carry out any accelerative work. It is noted, however, that increasingly attempts are being made to provide for recognition of accelerative agreements and for drafting that incorporates acceleration provisions. These innovations are to be welcomed.

C. *Drafting Acceleration agreements*

The terms agreed in any variation to the agreement's conditions are usually set out in a Supplemental agreement. Few precedents are available.[159]

From analysis in earlier chapters, it was found that a supplemental agreement should need to refer to the existing contract and identify the new target date for completion. A considered agreement might also deal with settlement of existing claims, revisions to the existing provisions of the agreement; and new arrangements or obligations with respect to completion of the balance of the works. Draft heads of terms are set out in Appendix F.

It is notable from the case studies that acceleration arrangements put in place by employers can also be a source of dispute, either for failure to address adequately issues required or due to unanticipated consequences. Some comments on the agreement follow:

- The form of the agreement made varied significantly between different projects. On some, the direction to accelerate was recorded only in a letter or meeting minutes.[160] In many cases there was no acceleration agreement at all;[161]

- Some agreements were premised upon the contractor's suggestion that some work be completed after the proposed date for possession or practical completion, but without any attempt being made to define which work would be completed later.[162] Inevitably, the extent of post-completion work was higher than the employer or design team had expected and caused more disruption to occupants than was anticipated;

- In many cases, the question of liability for existing delays was not resolved; nor was it clear how liability for future delays might be resolved;

- In most cases, the client team sought to secure a new completion date, with the onus

159 See for example Hughes and Barber (1992), and Construction and Engineering Precedents, by Levine.

160 See case studies for Kemsley paper mill and De Montfort University where the claim to recover costs was founded upon comments in letters and meeting minutes.

161 See case study of Barking Reach Power station

162 See particularly the case study for Victory House. In National Exhibition Centre, the initial accelerative actions were directed toward completing the entire facility, but in the face of further delays the employer reluctantly agreed that some work would be carried out after completion.

on the contractor to achieve the date. There was little or no focus upon either (a) the employer's outstanding obligations or (b) the risk of future delays;

- In all but two cases[163], cases the likely additional cost was not known; and

- the question of responsibility for cost of acceleration was not resolved.[164]

From analysis it has been found that successful deployment of acceleration agreements is rare. There are a number of recurring failures which might usefully be considered by draftsmen.

Costs incurred, and claimed, were higher than anticipated. It is common for employers to find that the additional resources said to have been consumed vastly exceeds the employer's earlier expectations. This occurs for several reasons. Where there was an arrangement whereby the contractor would be reimbursed additional costs incurred, the effect is to put all additional resources consumed on a reimbursable basis. No incentive is provided to the contractor to limit the additional resources introduced. Second, disputes with respect to actual resources consumed are not unusual, particularly where the site engineer's or clerk of work's records differ from the contractor's records. Third, even where it is suggested that the record of resources consumed is audited a practical difficulty is that the employer or his representatives rarely have a proper understanding as to the resources that might otherwise have been required; there is a dispute as to what resources are in fact 'additional'. Fourth, two additional complaints are frequently made: either that the original resource allowance in the tender was inadequate, or fifth, that the resources in fact deployed were inefficiently used. Employers rarely anticipate that work might be performed less efficiently than that envisaged at tender stage.

Further delays are incurred/work finishes late. That work is completed by the planned accelerated date is rare. The project finishes late anyway. The predominant reasons for time overruns are that either the original cause of the problem was not

---

163 Especially, case study for JP Morgan bank where the agreement was to accelerate for a lump sum.

164 Thus, even where lump sums were agreed, the employer took the view that nothing would be payable unless the contractor proved that the delays were not of his own making. This was not evident at the time the agreement was drafted.

removed or entirely new matters have arisen since the acceleration proposal was made that would in any event have delayed completion. In consequence, contractors either seek an extension of time or suggest further acceleration measures are taken. The employer often becomes reluctant to pay the full amount of contractor's payment applications and may seek to deduct liquidated damages for delay. Confusion over what programmes are current, what is the likely date for completion, and the respective parties' obligations under the acceleration agreement are not unusual.

Confusion over completion arrangements. Employer's tended to assume that the facility upon completion would be ready for immediate occupation. The definition of completion was a source of dispute.

Disputes over obligations and responsibility. The issue of why work was late in the first place is left to fester. It becomes clear that there were delays for reasons other than those originally alleged by the contractor. There are differences over what the contractor undertook to do, and for what cost.

It follows from the foregoing that template agreements are unlikely to provide adequate protection to all parties without proper consideration of the relevant facts and issues, and drafting bespoke amendments.

D. Liability for directed acceleration under the common law.

As noted above, in the absence of express provision or of agreement with the contractor, there will be no power to order a variation or change in regard to progress or the completion date.[165] Where the contractor has accelerated in response to an unauthorised or ultra vires instruction from the architect, or pursuant to a bald request from the employer, costs incurred as a consequence of the instruction cannot be recovered under the construction contract, but may arise outwith the construction contract, in either contract or restitution.

[165] See also *Hudson*, 11th Edition, 7.050

1. General principles: contract

For liability in contract to arise requires a finding that there was a binding contract, requiring an offer, acceptance of that offer and consideration. A request to accelerate would be an offer, accepted by performance on the contractor's part. Two possibilities arise: either an agreed variation to the existing construction contract, or a separate collateral agreement.

First, the contract terms might be varied by agreement. Under English law, the parties to a contract may effect a variation of the contract by modifying or altering its terms by mutual agreement: *Robinson* v. *Page* (1826). Thus, where the employer is desirous for the contractor to achieve completion earlier than the date by which the contractor is obligated to complete, in the absence of express provisions, the employer cannot validly vary the contract requirements without the contractors consent. A mere unilateral notification by one party to the other, in the absence of any agreement, cannot constitute a variation of a contract.[166] The employer interested in securing an earlier completion date may attempt to unilaterally change the contract completion date but will be unable, in the absence of agreement, to enforce compliant performance against the newly imposed date.

The terms of an agreement may be varied by a subsequent agreement, whether oral or written.[167] A simple contract may be varied by a subsequent oral agreement, and, *a fortiori*, an oral contract can be varied by a written agreement, or by a deed under seal (in such case there is, of course, no necessity for any consideration to support the variation). At common law a contract under seal could only be varied under seal.[168] In equity however it could be varied by a simple contract either written or oral. The equitable rule now prevails.[169]

Two typical situations found in practice call for discussion:

(i) Where the employer orally requests the contractor to complete the work by a date earlier than that contracted for. This would confer a benefit to the employer only, in the form

[166] *Cowey* v. *Liberian Operations Ltd.* [1966] 2 Lloyd's Rep. 45

[167] *Berry* v. *Berry* [1929] 2 K.B. 316

[168] *Kay* v. *Waghorn* (1809) 1 Taunt. 428

[169] See Section 44 of the Supreme Court of Judicature (Consolidation) Act 1925 which re-enacted the provisions of the Supreme Court of Judicature Act 1873.

of benefit of completion from an earlier date, or in the event of delay, recovery of damages for delay from the earlier date. Whilst the parties may agree to vary the contract in a way that can confer a legal benefit on only one party, the authorities take the view that such a variation does not generate its own consideration. Separate consideration is needed. This could be provided in the form of an implied promise from the employer to pay to the contractor the additional costs incurred in accelerating. This, from a practical perspective, is undesirable for three reasons: it may be difficult to establish that there was an implied promise to pay; it would inevitably be difficult to settle the sums payable to the contractor by way of additional costs incurred; and the time consumed settling both will ordinarily be excessive.

(ii) Where the contractor agrees to vary the completion date by substitution of a new completion date earlier than that contractor for, and the employer agrees to pay a fixed amount, or amount to be determined, payable by way of an addition to the contract sum. Such an agreement would confer a benefit on both parties. Where the parties agree to vary a contract in a way that can benefit either party, such a variation generates its own consideration. Such an agreement need only be *capable* of benefiting either party.[170] Thus, it will be of no aid to the employer, in the event that a varied contract completion date is not achieved, to seek to avoid the variation agreement.

The courts appear reluctant to allow bargains of this nature to flounder for want of consideration: any practical benefit flowing to the offerór would suffice.[171] The absence on agreement as to price also will not be fatal to such a bargain – the court will infer that a reasonable price is payable, in what is now referred to as a contractual quantum meruit.[172]

2. General principles: restitution

In pre-restitution days entitlement to payment depended upon the answer to one question: was

[170] Thus, where a contract of sale was varied by altering the payment was to be made, it made no difference that the new currency was later devalued in relation to the old, for at the time of the variation there could be not certainty how the two currencies would move in relation to each other: *W.J. Alan & Co. Ltd.* v. *El Nasr Export & Import Co.* [1972] 2 Q.B. 189, [1972] 2 All ER 127; See also *Woodhouse A.C. Israel Cocoa Ltd. S.A.* v. *Nigerian Produce Marketing Co.* [1972] A.C. 741, [1972] 2 All ER 271.

[171] *Williams and Roffey Brothers (Contractors) Ltd v. Nichols*

[172] Levine and Williams (1992) "Restitutionary Quantum Meruit – The Crossroads" (1992) 8 Const.L.J., 244 - 254

the work or any part of it performed in circumstances where the law would infer a promise by the recipient to pay for it? If an affirmative answer was forthcoming, the contractor would be paid a fair and reasonable sum for the work or such part of it as was subject to this implied promise. The traditional juridical technique for allowing these claims was to find or impute a contract between the negotiating parties. This implied contract theory is now discredited and unequivocally rejected by the House of Lords in *Westdeutsche Landsbank Goronzentralle v. Islington LBC.*[173]

These cases must now be resolved within the principle of unjust enrichment, the principal theory of the law of restitution. The principle was recognised by the House of Lords in *Lipkin Gorman v. Karpnale Ltd,*[174] following the recognition in Australia in *Pavey & Matthews Pty v. Paul*[175] Restitutionary liability is imposed by the law irrespective of the agreement of the parties[176] and is based either upon the principle of unjust enrichment or the protection of the reliance interest.[177] *Hudson*[178] notes that recovery on this basis is particularly necessary in the case of construction contracts where, once carried out, work and materials become the property of the owner on fixing to his land, so that no question of re-delivery or return of the benefit received, other than by payment, is practicable. This immediately raises difficulties that must be addressed in terms of the formulation of the elements of that cause of action.

The development of the law of restitution in England has meant that the principle of unjust enrichment has not manifested itself in a general action but as a number of specific substantive grounds upon which restitution may be ordered:[179] Work done under a contract terminated for breach; work done under a contract which is void; work done under an unenforceable contract; quantum meruit to fix a price or remuneration; substituted contract; and additional remuneration. The latter three categories are similar, and essentially are founded in contract. The circumstances must clearly show that the work is not to be done gratuitously before the court will, in the absence of an express contract, infer that there was a

[173] [1996] AC 669, at 710.

[174] [1991] 2 AC 548, 559, 578.

[175] (1987) 162 (CLR) 221

[176] Chitty, 30-002.

[177] Fuller & Purdue (1936) 46 Yale LJ 52.

[178] 11th Edition, 8.102

[179] See Chitty 30-178

valid contract with an implied term that a reasonable remuneration would be paid

Different authors use different methods of classification of restitution: the term *quantum meruit* is sometimes used interchangeably. The term has been used in various contexts: a quasi-contractual or restitutionary obligation based on incontrovertible benefit; a genuine implied contract based on request, free acceptance; and protection of reliance interest.

Where one is concerned with restitutionary remedies, the appropriate questions[180] are: "first, whether the defendant would be enriched at the claimant's expense; secondly, whether such enrichment would be unjust and thirdly, whether there are nevertheless reasons of policy for denying a remedy".[181] To similar effect is what Lord Clyde said in *Banque Financiere v. Parc*[182] "Without attempting any comprehensive analysis, it seems to me that the principle requires at least that the plaintiff should have sustained a loss through the provision of something for the benefit of some other person with no intention of making a gift, that the defendant should have received some form of enrichment, and that the enrichment has come about because of that loss."[183]

The enrichment may take the form of either a direct addition to the recipient's wealth, such as by receipt of money, or by an indirect one, where an inevitable expense has been saved.[184] Hence, acceleration which results in the employer avoiding late completion, and hence late use of the facility (or loss of rent) would be a benefit. It is, at least, clear that "the identity and value of the resulting benefit to the recipient may be debateable".[185] The service per se is treated as a benefit.[186]

---

[180] See also P Birks, "Modernising the Law of Restitution" (1993) 109 LQR 165: Restitutionary relief is available where there is an affirmative answer to the following five questions: Has the defendant received a benefit?; Has the benefit or enrichment been at the expense of the plaintiff?; do the circumstances of the receipt of the benefit or the enrichment fall within one of the established classes of injustice? Is no available defence applicable?

[181] *Banque Financiere de la Cite v. Parc (Battersea) Ltd* [1998] 2 WLR 475, per Lord Hoffman at 485; Chitty, 30-016; Goff and Jones pp 46-47.

[182] [1999] 1 AC 221

[183] At p 237. See also Lord Hoffmann at P.234. This was cited with approval in *Vedatech Corporation v. Crystal Decisions (UK) Ltd & Anor* [2002] EWHC 818 (Ch).

[184] Goff and Jones pp 16-27; Chitty 30-018

[185] *BP Exploration (Libya) Ltd v. Hunt (No. 2)* [1979] 1 WLR 783, at 799

[186] *William Lacey (Hounslow) Ltd v. Davis* [1957] 1 WLR 932; *British Steel Corp v. Cleveland Bridge and*

Relief will not be granted where it would be 'unjust' to allow the defendant to retain that received at the claimant's expense. Restitution is denied where the benefit is conferred pursuant to a common law obligation owed to the defendant; by the claimant acting voluntarily in his own self-interest or by the claimant acting voluntarily.[187] Of the 'unjust' element, according to Byrne J (1997) "It may be that the best that can be said for this element is that judges must apply their common sense having regard to circumstances of the case and the practice of the industry".[188]

It follows from the more modern understanding of the true basis of the liability that the amount recoverable in quasi-contract should, in theory, be assessed on the basis of the value of benefit received by the defendant which, although it may often be the same as remuneration based on reasonable cost incurred by the plaintiff, can on some occasions be very different, and sometimes perhaps markedly less.[189] The value of the benefit, in Australia at least, "will ordinarily correspond to the fair value of the benefit provided (eg remuneration calculated at a reasonable rate for work actually done or the fair market value of materials supplied"[190] Byrne J, sharing this view,[191] said "attention should be focused, not on the increase of wealth of the proprietor nor on the value of the end result, but on the services themselves, the effort of the contractor. If this is done, the task of valuation moves to assessment of the value of those services in the marketplace. In this way the tribunal might ask itself what the services might have commanded by way of a fair remuneration ...".

3. Direct instruction where work is in culpable delay

It will be clear that the foregoing principles apply where the date for completion is brought forward or where the contractor was in delay for reasons that were entirely matters for which he could be expected to be awarded more time.

Engineering Co. Ltd [1984] 1 All ER 504.

187 Goff and Jones, 63-65.

188 13 BCL 4, at 8

189 Hudson, paragraph 8.103

190 *Pavey & Matthews v. Paul* (1987) 162 CLR 221, per Deane J at 263

191 13 BCL 4, at 8

According to Tweeddale (2004)[192] where acceleration is requested following culpable delay, the employer is not liable for acceleration costs incurred. In support, he refers to *Ascon contacting Ltd v. Alfred McAlpine Construction Isle of Man Ltd.* where Hicks J said:

> "Acceleration not required to meet a contractor's existing obligations is likely to be the result of an instruction from the employer for which the latter must pay, whereas pressure from the employer to make good delay caused by the contractor's own default is unlikely to be so construed."

This view presupposes a direct causal relationship between the acceleration ordered and the delay incurred. Where a contractor is in delay, the default position is that the contractor will incur delay damages, often liquidated. The employer has a choice: to accept late completion, and retain delay damages, or to persuade the contractor to accelerate so that the period of delay might be reduced. It may be that the latter decision is driven by matters entirely unconnected with the delay.

Further, if it is right that the employer is not liable for acceleration costs, it may put him in a better position than that for which he bargained. Take the following example. A contractor starts work and is immediately delayed, for reasons of his own making, for ten weeks. He incurs little cost during the period of delay, as he had barely started work. Liquidated damages are priced at a low level of £1,000 per week, so the contractor is content to complete late. Toward the end of the project, however, the employer desperately needs completion of the facility as soon as possible. He stands to lose £5,000 per week of delay. He asks the contractor to accelerate, and says they'll sort out the finances later. If, by accelerating, four weeks overrun is saved, the employer enjoys a saving of £20,000, whereas the contractor may be put to great expense accelerating to which he would otherwise not have been put. The employer would have been enriched at the contractor's expense.

The views in *Ascon* were, in all probability made under the common assumption that prolongation costs and acceleration costs are both time-related, and hence of some equivalence. This assumption is misguided. Prolongation involves predominantly time-related losses, particularly those incurred in site overheads. It may be that volume related resources are redeployed profitably elsewhere during the period of delay, or indeed some loss of

[192] Tweeddale A (2004), "What are Acceleration Costs?" 20 Const LJ 115 at 117

productivity might be involved. Acceleration costs, however, predominantly involve efficiency related losses, as Tweeddale notes. (Indeed, Tweeddale failed to identify that contractors will incur compensating advantages in completing earlier in the form of a reduction in time-related costs incurred). The better view is that the employer should be liable for acceleration costs, even when the delay was due to a matter for which the contractor was responsible. In evaluation of the quantum, however, it would be right for credit to be given for compensating advantages incurred through earlier completion, including potentially the capacity to earn overheads and profit on other projects (a reverse *Hudson* claim). Allowing for compensating advantages of time-related costs would also avoid duplication, but would facilitate recovery of efficiency losses.

There is, in any event, a further difficulty with the proposition that the employer would not be liable for acceleration costs where the contractor is in culpable delay. If right, no prudently advised contractor would consent to acceleration. If he did accelerate, it is suggested that he would succeed in recovering in any event on the basis that the employer has incurred a 'practical benefit'.[193]

E. Conclusion

There is no common provision for direction of acceleration under the standard forms. Some standard forms make no reference to acceleration at all. Some forms attempt to incorporate as a variation to the agreement any deal achieved between the parties on whatever terms they make. More recently the NEC form has sought to provide for acceleration on a consensual basis but within the contract machinery. It appears that overly prescritive clauses, or clauses providing formula based compensation based upon activities impacted, are least likely to be accepted by contractors.

Few standard forms or precedents for acceleration agreements are available. Care should be exercised before using a precedent to ascertain provisions required, particularly with respect to new sectional completion arrangements, addition or omission of work, new definitions of completion, handover arrangements, information exchange and responsibility for older or concurrent claims.

---

[193] per Glidewell LJ in *Williams & Roffey*

An agreement between employer and contractor to accelerate the progress of work with a view to achieving early completion might be structured in a variety of ways. The contractor may agree to complete the whole or part of the works by a revised (earlier) completion date than that stipulated, or undertake to achieve completion of part of the work by a new interim completion date. The consideration might be in the form of an addition to the contract price, an agreement to underwrite the cost of all or limited acceleration, the award of a single bonus should early completion be achieved or a graduated bonus whereby the amount payable depends upon the completion date achieved. Introduction of bonus provisions may also involve a revision to liquidated damages provisions.

There are three bases upon which an agreement to pay for accelerative costs might arise. The first is under the construction agreement. Second, liability to pay may arise under a separate or collateral contract, whether agreed separately or agreed as a variation to the existing contract terms. Third, liability may arise in quasi-contract, or the law of restitution.

VIII. Liability for Voluntary and Implied Acceleration

This section deals with liability for acceleration that is not directly ordered, but is nevertheless undertaken by the contractor pursuant to an 'implied' order that work is accelerated, implied perhaps because of a refusal to grant extensions of time due. This tests the hypothesis that the English Courts might uphold a claim founded upon the US constructive acceleration doctrine

A. Implied instructions to Accelerate

This chapter has so far considered liability for acceleration where the instruction to accelerate was either given pursuant to a contractual provision or pursuant to an express instruction or order to accelerate. On occasion, no direct instruction to accelerate is given but the contractor nevertheless accelerates.

Voluntary acceleration per se is of no great concern to the employer. If a contractor, entirely without provocation or encouragement, decides to change the pace at which work is undertaken then that is a matter for him.

Where however the contractor accelerates allegedly in response to some action or inaction on the part of the employer or his agent the contractor may well seeks to recover from the employer additional costs incurred. As often as not, the contractor believes he can recover all additional costs incurred whereas the employer holds to the view that the acceleration was not ordered and thus he has no liability. The issues to be explored here are the potential scope and basis upon which the employer's liability for additional costs might be founded. Possible bases to be considered include the mitigation doctrine, a collateral contract, damages for breach of contract and the doctrine of 'constructive acceleration', recognised in certain US states, and which some argue ought now to be recognised under English law. This area of study seems to have taken on increasing importance within the last ten years, as contractors in UK have seemingly come more willing to accelerate parts of the works and as claims consultants have increasingly sought to advance claims on a constructive acceleration basis.

Implied or 'constructive' acceleration usually arises where the project is in delay, where the contractor advises the employer of delays and seeks an extension of time, but where the employer fails to grant the extension. Ostensibly the contractor is left in a difficult position. Were he to finish late he would incur delay damages. Were he to accelerate to attempt to complete on time, thereby avoiding delay damages, he may incur significant, irrecoverable, costs. Each course of action has consequences. The former, if eventually no extension were to be awarded at all, might result in liability to the employer for delay damages. The main contractor himself will have incurred additional time-related site overhead costs. Use of capital and staff for a longer period will arguably have deprived the contractor of the opportunity to earn a contribution to head-office overheads and profit from another project. Additionally time-related costs incurred by subcontractors would probably have to be reimbursed. Of course, if awarded the extension the contractor would expect to recover from the employer all of those costs incurred and losses made. If, on the other hand, the contractor alters his position, and takes steps to reduce the delay he will again incur additional expense. The difficulty is that efforts to accelerate might not be successful and acceleration-related expense might be very difficult to recover from the employer in the absence of an express instruction to accelerate.

Claims for constructive acceleration only arise because of non-resolution of extension of time claims. If an extension were to be granted immediately at the time of a delay, there would be no need for the contractor to accelerate. It appears there are several factors that contribute to such a scenario arising:

- Delays incurred rarely have a sole cause.[194] There are more likely to be many issues causing or contributing to delay, some of the contractor's own making and some compensable, leading to confusion initially over the real cause of delay;

- Extension of time clauses are invariably drafted in a form that does not permit an award to be later revised in a way that reduces the period awarded.[195] As awards have financial consequences, not least of which is a claim by the contractor for delay costs incurred, the architect or engineer will either make conservative awards where facts

[194] This is evident to the writer, from 18 years working with construction projects and analysing causes of delays. It also pervades the Case Studies.

[195] See for example JCT 1998 Standard form, clause 25. Research has not revealed any standard form in UK that permits reduction of time awarded, unless by agreement of the parties in, for example, an acceleration agreement.

are less than clear, or will delay making a decision pending receipt of more detailed particulars;

- Some forms put a limit upon the time during which an extension of time award is made, with a period of 12 weeks referred to in JCT forms.[196] This does not encourage the prompt resolution of the point;

- Although many changes have been taken to increase mid-project clarity, these have yet to have effect as intended. Under some JCT forms the pricing of variations, and agreement of cost, is encouraged before a variation is instructed.[197] A pre-pricing philosophy is also embedded with in the NEC ECC forms. It should be noted, however, that considerable effort is required on the part of the contractor to understand the time impact in advance. It is notable that quotations now made in advance typically exclude time effects;

- Procrastination on the part of employer and professionals is also a factor.[198] Thus, where there is any confusion over the period of delay, some professionals prefer to wait in order to generate a greater understanding first. Some, alternatively prefer to leave progress on site continue for many months in the hope that the contractor will in any event complete on time. Some architects have difficulty rationalising the contractor's reported enthusiasm for timely completion in the face of large delays, and the award of an extension of time, clearly concerned that the period of award my exceed the actual period of delay;[199]

- Whilst not appropriate, some employers may seek to exercise some views over extension of time awards. That view may be simply in respect of the timing and

[196] See for example JCT 1998 Standard form, clause 25.

[197] A provision for contractor's price statements was made first in the JCT Standard form 1998 edition, clause 13.

[198] This is also noted by Duncan Wallace in Hudson, 11th Edition, page 1183

[199] See Case Study for Great Pulteney Street, for example where the contractor sought an extension to January, but in fact completed work well in advance of that date.

process for evaluation or may be in respect of substantial matters.[200]

From the architect or engineer's perspective, if a project is in delay and the contractor seeks additional time, time is required to evaluate the claim made. That evaluation is likely to depend upon his own perception of matters influencing progress and belated receipt of documents from the contractor. That the architect/engineer may have to account to the employer for a rationale behind the award may increase the time taken to ensure that a properly founded award is made. That the extension provides relief against delay damages and may provide grounds upon which additional costs are claimed will increase his concern that the award was the right one to make.

In the course of research, it is clear, from analysis of case studies reviewed, that the contractors adopted a variety of techniques in order to limit their potential exposure to acceleration costs.

(a) In each case, the contractor suggested to the employer that 'special measures' were taken with a view to achieving completion by the contract completion date or within a reduced period of delay, in the hope that the employer would agree to such a request. In four case studies the employer's response was to suggest that all delays were the fault of the contractor and that the contractor should finish by the contractual date for completion in any event. The inference was that the employer was not to be liable for acceleration, although in each case this was not said directly;

(b) In two instances, the contractor chose an additional tactic. He complained that without knowing the period of extension he was due, he is unable to plan the ongoing work.[201] This confused two issues: the date by which he might contractually be obligated to complete, whether extended or otherwise, and the date by which work would naturally complete were work continued as planned. Some architects did have some sympathy with this argument. The benefit to the contractor was that it helped achieve a quick understanding of the extent of the

[200] See for example *Perini v. Commonwealth of Australia* [1969] N.S.W.R. 530; 12 BLR 82; *Morrison-Knudsen v. British Columbia Hydro* (1978) 85 DLR 3d 186

extension he might not receive and hence the extent of likely exposure;

(c) In each case, the contractor eventually proceeded with limited acceleration efforts in any event. Seemingly their reason for doing so in each case was in the hope that costs incurred in accelerating might be recovered as delay damages in the event that further events might arise. It seems that in each case the contractors thought it most unlikely that further delays would not be incurred in which case the prospect of recovery was high.

So why, it might be asked, is the review of liability for implied acceleration of importance? First, because there is a developed solution US that many others in UK are keen to adopt. Second, this is an area in which there has been considerable debate. And third, the issue is not UK centric, affecting projects in other countries. Some case law in this area originates from Canada and Australia.

Analysis of the contractor's economic and contractual interests suggests several reasons why a contractor might decide to take accelerative measures without an express instruction or confirmation from the employer that additional cost of so doing will be reimbursed.

(a) First the contractor has a financial interest in reducing his own exposure to additional cost. He may potentially be put to reimbursing subcontractors additional time-related costs incurred by them, and may suffer time-related site running costs of his own. In addition he may be exposed to liquidated damages payable to the employer. Accelerative action, whether by rescheduling or rearrangement of package procurement in an effort to reduce his exposure overall is one where the impact is potentially measurable. The alternative, is to concentrate on pursuit of his extension of time claim in the hope that an extension is awarded in full, thereby providing relief from liquidated damages and to pursue recovery of loss and expense that includes all subcontractor's losses. The three difficulties with the latter are that recovery might not be secured for many years; the recovery might fall short of anticipated recovery; and costs incurred in securing recovery may exceed the sums claimed. The

---

[201] Particularly Kings Lynn Power station and Kemsley Paper works.

contractor's financial interest is not best served by pursuit of claims alone;[202]

(b) Second, there is a chance that the employer may agree later to reimburse acceleration costs where the measures taken are clear and where those measures were seen to be successful.

(c) Third, there is a chance during the period accelerative measures are in place that a new difficulty will arise. This may provide to the contractor the opportunity to characterise accelerative costs as being a consequence of the new intervening event.

The essential question that arises is on what grounds, if at all, might the contractor before an English tribunal or court recover additional costs incurred on the basis of an 'implied' instruction to accelerate. The remainder of this chapter considers first the US doctrine of 'constructive' acceleration, which permits recovery in defined circumstances, second how the doctrine has been applied across other common law jurisdictions, and third how liability for implied instructions to accelerate might be treated under English law.

B. Doctrine of constructive acceleration

According to the doctrine of constructive acceleration, as fashioned by the US Federal courts, a contractor can recover extra expense that he was required to incur in completing a contract in accordance with a programme which has not been updated in a timely fashion to include allowances by way of extensions of time for excusable delays.[203]

Source and development of the doctrine

US federal courts and federal appeal boards developed the doctrine in their decisions on disputes arising under US federal contracts.[204] Explanation of the doctrine's source requires

---

[202] For a notable example where a contractor chose to directly address its sucontractors's progress issues see *Williams v. Roffey Bros.* [1991] 1 QB 1. There, the main contractor agreed to pay additional sums to a subcontractor to secure timely completion of the project, after the subcontractor had said be was about to go into liquidation and suggested payment of additional sums to complete on time.

[203] *Continental Consolidated Corp. v. United States* 20 CCF (CCH) 83,761 (Ct. Cl. 1972)

[204] Contracts in which the United States Government, a state government or a government agency was a party.

first some explanation of the federal contracts' dispute resolution mechanism and provisions for valuation of change orders.

The US government has maintained, since the turn of the century, standard forms for supply and for contracting. Under both forms, the 'contracting officer' represented the government. Disputes arising under the contract would be referred first to the 'contracting officer' (whose role was akin to that of the Engineer under UK domestic engineering forms). The dissatisfied contractor or supplier could refer the dispute thereafter to either a board of contract appeals, or to the US Court of Claims.[205] The boards[206] were established to facilitate inexpensive and speedy resolution of disputes, thereby enabling disputes to be resolved without the expense and time consuming procedures of litigation in the Court of Claims. Those boards, however, were only empowered to hear disputes arising *under* the contract, such as relating to the value of work executed. On other issues boards had to declare they did not have jurisdiction.[207] All other claims arising, particularly claims for breach, had to be referred separately to the Court of Claims. Naturally, over the course of time, boards came to fashion disputes and decisions in a way which allowed them to retain jurisdiction.

The changes clause applying to fixed price supply contracts, as it was drafted in 1973, provided that:

> The contracting officer may at any time, by a written order, and without notice to the sureties, make changes, within the general scope of this contract, in any one of more of the following: (1) Drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (ii) method of shipment or packing; and (iii) place of delivery. If any such change causes an increase or decrease in the cost of, or the time required for the performance of any part of the work under this contract, whether changed or not changed by any such order, an equitable adjustment shall be made in the contract price or schedule, or both, and the

205 This is described by many authors including Duncan Wallace (1986) at 5, 144 to 151; Cohen L & Miller J (2002) 18 Const.L.J. 378, 379; Cushman et al (1996) Chapter 17.

206 Boards still in operation today include the Armed Services Board, Postal Services Board, General Services Board and Interior Board.

207 See for example *Hagerman Construction Co.* IBCA 183, 59-1 BCA 2905 (1959) where the Interior board of contract appeals considered that a contracting officer's failure to issue a suspension order was a breach of contract issue and therefore one over which it did not have jurisdiction.

> contract shall be modified in writing accordingly.[208]

Similarly, the changes clause applying to fixed price construction contracts was as follows:

> (a) the contracting officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the general scope of the contract, including but not limited to changes: (i) in the specifications (including drawings and designs); (ii) in the method or manner of performance of the work; (iii) in the Government-furnished facilities, equipment, materials, services, or site: or (iv) directing acceleration in the performance of the work. ...
>
> (d) If any change order under this clause causes an increase or decrease in the contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any order, an equitable adjustment shall be made and the contract modified in writing accordingly' ... provided that in the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the contractor in attempting to comply with such defective specifications.

A notable feature of these provisions is that each requires the contracting officer's order in writing for changes to be made. There is no provision for instructions or changes made orally. In practise, an equitable adjustment to the contract price for changes was only made where a contract compliant change order was issued. This, for contractors, proved problematic. Often changed work was undertaken without a written order. Those change orders were typically non-compliant either because they were not in writing or extended to matters for which the contracting officer was not empowered to issue directions. Outside the federal system, lack of formality did not necessarily defeat a claim for payment. A claimant might have argued that formal requirements had been waived or modified, that the defendant was estopped from relying upon lack of formality, or might have argued that the non-compliant instruction or change order gave rise to a collateral contract, on the basis of an implied promise to pay. But jurisdictional limitations on the Boards of Contract Appeal meant that the boards could not address those common law exceptions.

Accordingly the boards developed the fiction that notwithstanding the formal requirements, the government was bound as there had been a 'constructive' change. This was explained and

---

[208] ASPR 7-103.2.

upheld in *Ets-Hoskins Corp. v. United States*:[209]

> "Where a [federal] contract contains the standard 'changes' provision and the contacting officer without issuing a formal change order, requires the contractor to perform work or to utilize materials which the contractor regards as being beyond the requirements of the pertinent specifications or drawings, the contractor may elect to treat the contracting officer's directive as a constructive change order and prosecute a claim for equitable adjustment under the changes provision of the contract."[210]

The doctrine of constructive change order emerged as a composite of the various arguments of waiver and exceptions to the formal requirements for a change order. Boards noted that a contracting officer might delegate his authority to technical representatives. According to the now well-developed doctrine the US government is bound by the directives of the representative: it has been held in numerous US cases that the inspector representative has 'constructively changed' the contract work by his inspection activities.[211] The boards' development of the 'constructive' change was only necessary because those common law arguments were not available to parties before them. The practical impact was to deny government agency's the opportunity to make pleas for decisions of Boards to be set aside on the grounds that certain claims could be heard only by the courts.[212]

The constructive acceleration doctrine was first developed in *Standard Store Equipment v. US*[213] as an extension of the constructive change doctrine. In that case, heard before the Armed Services Board of Contract Appeals, the government failed to make the site available to the contractor as planned but refused to grant time extensions, insisting upon the original date for completion. The board noted first that the changes clause (as it was drafted then) was wide enough to accommodate changes to the sequence or time in which work was carried out: it could accommodate a government order to accelerate. It followed that an acceleration order that was not in writing or did not comply with formal requirements might be a constructive change order. Next, the board decided that when the contractor had a right to time extensions,

---

[209] 420 F.2d 716 (Ct. Cl. 1970)

[210] *Ibid* at 720

[211] *Industrial Research Associates, Inc.* 68-1 BCA (CCH) 7069 (DCAB 1968), at 32,685-86.

[212] These jurisdictional issues are discussed at length in *Lee Company & Associates v. US* (1967) 385 F. (2d) 438, per Davis J at 451 (US Court of Claims)

[213] ASBCA No 4348, 58-2 BCA 1902

an order to complete work without an extension was the equivalent of a change order to accelerate.[214] In its decision for the plaintiff, the board decided that the cost of accelerating could be recovered as an equitable adjustment to the contract price, under the change order provisions. In essence, the board managed to redefine the acceleration as a change order under the contract, and thus within its limited jurisdiction brought resolution.

In cases with similar factual situations, the rule set in *Standard Store Equipment* was followed for many years. In several cases in the early 1960's several decisions retested the rule in slightly different factual situations.

In *Mechanical Utilities, Inc*[215] in 1962 the contractor had suffered excusable delays. After the contracting officer first insisted upon timely completion, he declined to discuss extensions of time and notified the contractor that a default termination was contemplated. The contractor accelerated and later claimed the costs incurred. The board noted the coercive effect of the government's threat to terminate if the work did not keep up with the pace expected by the programme. This, the board decided, was the equivalent of an order to accelerate.

In *Keco Industries, Inc*[216] in 1963 the contractor was ordered to make changes in the production of air conditioning units but was not given an extension in the delivery schedule. The contractor claimed he was compelled to accelerate by changing production methods board. There was no order that explicity required the contractor to follow the original schedule. Finding for the contractor, the board held that "The refusal to extend the delivery time, coupled with assessment of high liquidated damages, required appellant to accelerate performance. Where a contracting officer requires the contractor to adhere to the original performance schedule, refusing to grant an extension to which the contractor is entitled, such action constitutes an acceleration of the time of performance and entitles the contractor to an equitable adjustment."

---

[214] Although it was not said directly, the government's failure to grant an extension of time was implicitly a crucial fact that allowed the board to decide that the lack of an extension was equivalent to an order to accelerate.

[215] ASBCA Nos 7345, 7466 1962 BCA 3556

[216] ASBCA No 8900 1963 BCA 3891

In *Hyde Construction Co.*[217] in 1963 the contractor accelerated in response to an oral request from the engineer. The board, in its opinion, allowed the contractor's claim on the basis that it could see no difference between a request and an order.

In *Aero Corporation*[218] in 1964 the supply contractor was delayed by a long strike. The contracting officer was found to have discussed this at the time with the contractor and agreed that the contractor would nevertheless attempt to maintain work to schedule. Considerable pressure was exerted to achieve timely completion. In the event the contractor's claim failed for want of his request for an extension of time, and in the absence of any refusal by the contracting officer to refuse such a request. This aspect of the case was later criticised in *Electronic & Missile Facilities* (see below)

In *Olin Mathieson Chemical Corp*[219] in 1963 denial of the claim was on the basis that the government had not explicitly required acceleration. Urgency of deliveries had been encouraged but this was not sufficient, thought the board.

Aspects of these decisions were difficult to reconcile reflecting perhaps each board's attempt to find solutions independently. What differentiated these decisions were the facts required to establish a direction to maintain the original progress schedule. These cases have two matters in common. In each case the court was looking for some clear evidence of a direction by the government agency that it required completion absent a time extension. In each case the court's analysis of the facts proceeded on the basis that a request to accelerate, if one could be found, was a constructive change order. The acceleration was 'constructive' because it was there in fact, notwithstanding lack of compliance with the necessary formalities: It was not directed by agreement or in accordance with the contract's formal provisions.

In *Electronic & Missile Facilities*,[220] a case that was a watershed reported in 1964, the board restated the doctrine's rule, repeating *Standard Store Equipment* when it said:

"When a contractor who has been excusably delayed is directed by the

[217] ASBCA No. 8393. 1963 BCA 3911

[218] ASBCA Nos 7920 & 8237, 1964 BCA 4268

[219] ASBCA Nos 7605, 1963 BCA 3983 *aff'd* 179 Ct. Cl. 368 (1967)

[220] ASBCA No 9031, 1964 BCA 4338

> government to maintain the original progress schedule and completion dates despite the excusable delay, this constitutes an order to accelerate for which the contractor is entitled to an equitable adjustment in price under the Changes clause."

The dispute arose out of the polaris missile project. As delays were encountered due to bad weather the government indicated that there they were not empowered to award extensions and there was none to give. It also began to calculate liquidated damages and ignored the time extension sought. Ultimately the government relented and awarded an extension so as to provide relief against liquidated damages. By this stage the contractor had accelerated. The board focused on the government's 'actions and course of conduct' rather than seeking a specific direction that the schedule be maintained. The board was satisfied not by explicit refusals of time extensions or official directives to accelerate or threats to terminate. Rather it was convinced by an array of facts that the Government's actions fairly persuaded the contractor that the acceleration was called for and desired.

But *Electronic & Missile Facilities* is of significance for another reason. The Government's delay in granting the contractor an extension of time, a delay for which, the board said, there was no justification, seemed to be a decisive issue for the board. The board recognized that

> "a mere failure or refusal to act on a notice of delay and grant the time extension to which the contractor is entitled before completion of performance is insufficient to constitute an acceleration order entitling the contractor to a price adjustment"

The board had noted that the government had gone beyond a refusal to process requests for time extensions but by its actions and conduct required the appellant to adhere to the original schedule. This is in marked contrast with *Olin Mathieson*, a case decided in the previous year, where the contractor's claim failed as there was found to be no direct action calling for timely delivery to site. There the government's unreasonable delay in granting extensions was notable, but not decisive. Expessions of urgency with respect to deliveries were equally found not to be sufficient to support. Thus, the delay in dealing with extensions was noted in *Electronic & Missile Facilities* as a factor that might help to persuade a board that the government really intended acceleration to be implemented. The significance of *Electronic & Missile Facilities* was that 'government actions' referred to by Judge Spector had been extended to include an unjustifiable delay in awarding an extension of time.

In 1972 the decision by the Court of Claims in *Continental Consolidated Corporation* was made in the contractor's favour although the contactor had not formally requested an extension of time and no formal order to accelerate had been issued by the government. Trial Judge Spector neatly summarised the doctrine as an extension of the constructive change order when he said:

> "... the absence of a written directive to accelerate is not fatal to a claim of constructive change based upon acceleration. The principle enunciated is that Government actions which require the contractor to complete in accordance with a progress schedule not updated to include all claims for excusable delays then outstanding is a constructive change for which the contractor is entitled to an equitable adjustment under... the contract."

Judge Spector also made it clear that the pending claims for the time extension need not arise as formal requests by the contractor but it was enough that the government had actual or constructive knowledge as to the existence of excusable delays. Cuneo and Ackerly (1975)[221] took the view, after consideration of *Continental Consolidated Corporation*, that it was no longer the law (nor they opined should it ever have been) that a contractor must file a written request seeking extensions of time which must be denied before the contractor is entitled to cost incurred in accelerating. Further, they suggested it was not essential that contractors do that which was futile or obvious, such as notifying the existence of excusable delays when these are already well known to the contracting officer, or formally request an extension when the contractor is fully aware that the completion date is fixed and such a request is pointless. They noted with regret that some boards were continuing to deny equitable relief for want of those futile actions.

By 1977 it was settled that claims based on the doctrine might be satisfied in the absence of a formal request where there is a clear indication from the owner that no delays in the schedule will be tolerated.[222]

The doctrine today

The basic elements of a constructive acceleration claim are well established: excusable delay;

---

[221] "Delays, Suspension, Acceleration" Government Contracts Monograph No. 9, Government Contracts Programe, The George Washington University

[222] Corbetta Construction Co. of Ill., Inc., 77-2 BCA (CCH) 12,699 (PSBCA 1977)

notice to the defendant of the excusable delay and request for an extension of time; refusal or failure to grant the requested extension within a reasonable time; express or implied order to accelerate; and actual acceleration.[223] Where successful, the contractor can recover acceleration costs incurred. These have developed over time. The leading case was *Norair Engineering Corp. v. United States*:[224]

> "it is generally recognised that, in order to recover for the increased costs of acceleration under a changes clause, plaintiff must establish three things: (1) that any delays giving rise to the order were excusable, (2) that the contractor was ordered to accelerate, and (3) that the contractor in fact accelerated performance and incurred extra costs."[225]

Simon (1988)[226] notes that the right to a constructive acceleration claim arises when a contract party has a right to an extension of time but the owner nevertheless expressly or constructive order that the contracting party comply with the original schedule. This creates the constructive acceleration. It is now settled that a request for an extension is not needed when there is a clear indication from the owner that no delays in the schedule with be tolerated.[227]

The Federal Contracts Disputes Act 1978 widened board's jurisdiction to hear claims for breach as well as claims under the contract.[228] This might, in principal, have removed the need for the use of constructive claims doctrine, as boards are now empowered to hear argument on waiver, estoppel, and breach issues.

In a more recent restatement of the elements, Miller J said:[229]

> "To prove constructive acceleration, five elements must be established: First, there must be an excuse for delay. Second, the [employer] must have knowledge of the delay. Third, the [Employer] must act in a manner which reasonably can be construed as an order to accelerate. Fourth, the contract must give notice to the [employer] that the order amounts to a constructive change. Fifth, the contractor must actually accelerate and thereby incur added costs."

---

[223] *Norair Engineering Corp. v. United States*, 666 F.2d 546 (Ct. Cl. 1981)

[224] 666 F.2d 546 (Ct. Cl.1981)

[225] at 548.

[226] Page 307.

[227] Corbetta Construction Co of Illinois, inc. 77-2 BCA (CCH) 12,699 (PSBCA 1977)

[228] See Gem Engineering Company v. Department of Commerce (1996) GSBCA 13566-COM

[229] *Fru-Con Construction v. US* (1999) No. 97 43 Fed Cl. 306

Claims are bound to fail if any element is missing, as has been clear from many US decisions. The application of the doctrine outside US is dealt with in the following sections.

As a preliminary observation, however, from both from *Norair* and *Fru-Con's* list of elements required, it is notable that neither requires breach by the employer to be proved. Thus, it requires excusable delay and, in the face of that excusable delay, a request for timely performance. Whilst it is tempting to presuppose that the request for timely performance is a breach of an obligation to make a time award, it does not follow directly. It is, alternatively, possible that compliance with the original schedule is being sought as a new requirement, that is to say that the employer thereby requests a change to the conditions. That is arguably a change capable of acceptance, a change (albeit) outside the contractual variation provisions) which can either be paid at a price or on a quantum meruit.

C. Implied acceleration in Australia

In researching this thesis, no reported cases in Australia or New Zealand have been identified where any specific reference to constructive acceleration was made. Nor is the concept referred to in the leading texts on construction law. The decision of Macfarlan J in *Perini Corporation v. Commonwealth of Australia*[230] is however of note, as it is cited in UK as potentially founding a claim for constructive acceleration. Macfarlan J upheld the claimant's contention that there was an implied term to the effect that the defendant was contractually bound not to interfere with the proper performance of the Director's duties (acting as engineer) and the defendant was contractually bound to ensure that the Director did his duty. Referring specifically to extension of time applications, and how these might be handled, it was said:

> "[T]he decision must be given in reasonable time. The measurement of reasonable time in any particular case is always a matter of fact. Plainly the director must not delay, nor may he procrastinate, and in my opinion he is not entitled simply to defer a decision. On the other hand his is, in my opinion, and this follows from the nature of his obligation to give his own personal decision on the point, necessarily obliged to have available for that consideration such time as is necessary to enable him to investigate the facts which are relevant to

230 [1969] 2 N.S.W.R

making it."[231]

Finding a breach of the term, the court concluded that the contractor could recover acceleration costs incurred as a consequence of the employer's breach in failing to ensure the contract administrator gave consideration to an extension of time application. The critical point here, it is suggested, was not that the Director took too long to make a decision, but that he had not commenced the process at all. Essentially the court made a finding in what was probably an extreme situation, finding a breach without difficulty.

The case has been cited numerous times in Australia with respect to the implied term, but no reported cases are evident with respect specifically to a claim based on the 'constructive acceleration' doctrine. This suggests that Courts in Australia are more likely to award damages where a clear breach is identified without a laborious reference to the US doctrine.

D. Implied acceleration in Canada

There are number of decisions in Canadian reports dealing with claims involving implied acceleration. A review of these indicates that liability has been found on a number of different bases, unlike in US where liability centred around the 'constructive acceleration' doctrine. Several bases: breach/repudiation; constructive acceleration and mitigation.

The decision in *Morrison-Knudson Company v. British Columbia Hydro & Power Authority*[232] is often cited as an example of common law jurisdiction supporting an acceleration claim. The case arose from construction of a dam across the Peace River. Mr. Justice Macdonald (as he then was) He said in his judgment:[233]

> Throughout, the plaintiffs were pressed to complete their work by the dates specified in the contract. The chairman's two letters ... called on the contractor to take all necessary completion by the contract dates, and made it plain that failure to do so was unacceptable to the owner. The second letter was written after a Hydro senior official had accepted the fact that there would be no Peace River power until 1969, but decided that the contractor would not be told of this, and instead, the penalties involved in not completing the contract on time

[231] 12 BLR 82, at 102.

[232] (1978), 85 D.L.R. (3d) 186 (B.C.C.A)

[233] *Morrison-Knudsen Company v. B.C Hydro &Power Authority* (No. 2) 1978, 4 W.W.R. 193., (part 11.3)

> would be pointed out to him..."

The British Columbia Court of Appeal, agreeing with the trial judge, found Hydro's interference with the engineer and the failings of the engineer to be breaches of contract, and said:[234]

> "The engineer ought to have either granted extensions of time or authorised payment for acceleration. He did neither. It is no defence to say that the decisions were not made by him; they ought to have been..."

Breaches of payment terms were found to be fundamental breaches. The found, however, that the repudiatory breach was not accepted so the contractor was left to remedies under the contract rather than in quantum meruit. Curiously, the court came to this conclusion without any reference to the expression "constructive acceleration".

In *W.A. Stevenson Construction (Western) Ltd. v. Metro Canada Ltd.*[235] the court found an anticipatory breach of contract by the employer.

> Throughout this job the contractor was told he had to meet the milestone dates in the contract. Conditions of work which delayed the execution of the contract were forced on it by the owner (e.g. non-removal of buildings). Weather conditions plainly impaired the ability to perform. If the owner insisted on performance by the contract date, the slowed work had to be made up with extra resources of capital and labour. This compression in time is one definition of acceleration. Like the Red Queen, the contractor had to run faster just to stay where it was in relation to the time frame of the contract.
>
> If extensions of time for owner-caused delays are refused, and a contractor accelerates to overcome those delays plus others which are solely his responsibility, he is entitled to be paid the portion of his acceleration costs attributable to the owner's default
>
> In the case at bar, there were two concepts in relation to time: a mandatory contractual obligation to extend time for third party acts or acts of God, and a discretionary power to pay in the case of an owner-caused delay or failure to do an act together with a date adjustment. In my opinion, the owner failed to do its duty as to the first obligation and is in breach of contract, and having failed to make any proper financial adjustment for the second, must bear proven

---

[234] At page 221.

[235] (1987) 27 C.L.R. 113 (B.C.S.C.); 1987 A.C.W.S.J. LEXIS 40079; 1987 A.C.W.S.J. 458527; 7 A.C.W.S. (3d) 124.

monetary consequences... [236]

> [180] It is my opinion that the above was almost completely the fault of the owner. I think there was one major reason for all this. This was a very large, novel, and complicated project, to be built through a major, urban centre. In a deliberate, anticipatory breach of contract by means of a policy decision, the owner decided that the time for completion would not be extended, no matter what the cause. This inflexible straitjacket seriously distorted the administration of the contract, and I think, executive attitudes. Deprived of the remedy of time extension, but still trying to complete on budget, management appeared to me to be unwilling to face the fact that extra money would be required to overcome the obstacles, even when a principal and obvious one labour trouble - could not be attributed to either party. The pressure to complete on time for Expo 86, 1 think, skewed many managerial decisions, and on occasion, they were simply made too late to avoid major strains on the contractor's organization and subsequent monetary consequences."

Like *Morrison-Knudson*, this decision was breach based and reached without reference to the US doctrine. The decision was based upon an obvious refusal on the employer's part to award an extension when one was patently due.[237]

A different approach was taken in *Emil Anderson Construction Co. v. British Columbia Railway Co.*[238] Here the claimant contractor, at first instance, pleaded a claim based upon constructive acceleration,[239] relying upon *Morrison Knudsen* and *Electronic & Missile Facilities Inc*, and hence directly referring to the US doctrine. The claim failed, as the trial judge found that the contractor had accelerated voluntarily, rather than as a direct result of the employer's inducements to progress. On appeal the claim was changed to "a claim for breach of an express term of the contract which ... provides the contractor an unqualified right to extensions of time for owner-caused delays or to damages in the event that extensions are not granted."[240] The Court of Appeal recognised as the claim as having been pleaded initially as a claim for constructive acceleration arising out of the breach of an implied term for payment of the additional costs of accelerated work."[241] It is perhaps significant that neither Court

[236] At paragraphs 148 to 150

[237] Other points relating to notice provisions were taken by the employer, but these were found to have been waived. It was also found that the employer had notice of the issues through meetings and correspondence.

[238] (1988), 28 C.L.R. 90, (B.C.S.C.); (1991) 45 C.L.R. 201, (B.C.C.A.).

[239] Possibly the first reported use of the term in the higher Canada Courts

[240] At paragraph 48.

[241] At para 48.

suggested that a claim based on the constructive acceleration concept would never be entertained.

Dilcon Constructors Inc v. British Columbia Hydro & Power Authority[242]; concerned a claim arising from drainage work. Having failed to establish fraud (relying upon *Morrison-Knudson* and *W.A. Stevenson*), the claimant contractor sought to found its acceleration claim on allegations that Hydro failed to act in good faith with respect to performance of the contract. Allan J found that acting in good faith was a general principle of contract law in US and Quebec (under the Civil Code of Lower Canada) there was no such general doctrine recognised in British Columbia. It was also noted that older cases upholding the exclusive jurisdiction of the engineer to decide on matters did not apply to the modern construction setting.

In *BG Checo International Ltd. v. British Columbia Hydro and Power Authority*[243] the majority noted that the measure of damages in contract is that the plaintiff is to be put in the position it would have been in had the contract been performed as agreed. The contract stated that "clearing of the right-of-way and foundation instalment has been carried out by others and will not form part of this contract". That work was not done. B.C. Hydro was found liable in breach of contract, and for negligence, as a result. With respect to the claim for breach of contract, the majority said this:

> Checo is to be put in the position it would be in had the work site been cleared properly, and is therefore to be reimbursed for all expenses incurred as a result of the breach of contract, whether expected or not, except, of course, to the extent that those expenses may have been so unexpected that they are too remote to be compensable for breach of contract. We note that in this respect, the test for remoteness in contract may be of no practical difference from the test for reasonable foreseeability applicable in tort ... Viewed thus, the damages in contract would include not only the costs flowing directly from the improperly cleared work site, *but also consequent indirect costs such as acceleration costs due to delays in construction.* [Emphasis added]

In *Foundation Co of Canada Ltd v. United Grain Growers Ltd*[244] Brenner J said:

---

[242] (1992), 7 C.L.R. (2d) 22 (B.C.S.C.)

[243] [1993] 1 S.C.R. 12

[244] (1995), 25 C.L.R. (2d) 1 (B.C.S.C.); 1995 CanLii 3392 (BC SC)

> The law on express or constructive acceleration was discussed by this Court and the Court of Appeal in *Emil Anderson*. What is clear from a consideration of that case is that an obligation to pay costs for a direction to accelerate requires an express direction in writing signed by the owner or contractor directing the acceleration. Was there such an express direction in this case?
>
> On July 21 CMI advised FCC that it was accelerating its work, at an estimated cost of $25,650.00, in order to recover lost schedule time. This acceleration occurred in response to numerous prior delays and repeated verbal requests from Campbell to accelerate. CMI also accelerated its work in an effort to mitigate the increased costs that it was incurring as a result of the delays caused by others. However, there was no express written direction to accelerate from FCC or CWMM. Hence it is not recoverable as an acceleration expense except to the extent it was a reasonable response to the delays that CMI had experienced, which would permit recovery as an impact or mitigation cost. [245]

And continued[246]:

> ... To the extent that the CMI acceleration was a reasonable response to delays caused by UGG and CWMM, those costs are recoverable impact costs. ...
>
> Overtime, if caused by delay, is an appropriate impact cost according to the judgment of the Supreme Court of Canada in *B.G. Checo*. However overtime directed by the prime contractor is not payable by the owner in the absence of an agreement, express or implied, to do so. On its evidence, FCC never obtained the agreement of CWMM or UGG to the CMI acceleration program. Therefore FCC cannot succeed in a claim for indemnification except to the extent that CMI's acceleration program can be characterized as an impact cost caused by the acts or omissions of CWMM or UGG.
>
> In my view ...I consider that CMI's net acceleration claim can be accurately characterized as an impact claim. UGG recognized this when Pope stated to Skodje at the Cannery meeting that UGG would see to it that CMI "did not get hurt". ...

In *TNL Paving Ltd v. British Columbia (Ministry of Transportation and Highways)*[247] Beames J concurred with the decision in *Dilcon* that there was no general duty to act in good faith but found that there was a specific duty on the Ministry Representative, when exercising discretion granted to him pursuant to the terms of the contract, to exercise that discretion in good faith. There was a further finding that the defendant had breached the obligation to act in

[245] *ibid* at 657 to 658

[246] *Ibid* at 686 to 688

[247] (1999), 46 C.L.R. (2d) 165 (B.C.S.C.); 1999 BCSC 16060

good faith with respect to the refusal to grant any extension of time or reimbursable delay.

In *Golden Hill Ventures Ltd v. Kemess Mines Inc*[248] Mr Justice Burnyeat said, dealing with the implied duty of good faith:[249]

> Where an owner has been expressly given power or discretion over a matter, there is an implied duty to act in good faith when exercising such power or discretion: *West Coast Paving Co. v. British Columbia* (1984), 4 C.L.R. 300 (B.C.S.C.) at p. 308 and *Dilcon Constructors Ltd. v. British Columbia Hydro & Power Authority* (1982), 7 C.L.R. (2d) 22 (B.C.S.C.) at p. 69.
>
> In *West Coast Paving*, Spencer, J. described the concept of good faith in this type of construction contract as follows:
>
> This contract expressly gives the defendant, through its engineer, the power to direct the manner and schedule of performance of the work. ...It says nothing about how the engineer shall go about making his decisions and giving directions. Since he is employed by the defendant, he is entitled to advance the defendant's best interests in giving his directions but I am of the view that there must be some standard of judgment implied in this contract, otherwise the engineer could act in an entirely arbitrary manner and require a standard of performance from the plaintiff far beyond what is usual in the construction industry and beyond what is contemplated by the contract. I think it is necessary to judge performance under the contract that common sense should prevail and that necessity requires the implication of a common sense term. It is that the engineer should direct the plaintiff in accordance with proper engineering in construction practice. (at p. 308)
>
> The duty of good faith required Kemess to exercise its discretion in accordance with proper engineering and construction practice and not to exercise its discretion arbitrarily without reasons. Any failure of Kemess to grant extensions of time which were properly due constitutes a breach of this duty: *TNL Paving Ltd. v. British Columbia (Ministry of Transportation and Highways)* (1999), 46 C.L.R. (2d) 165 (B.C.S.C.) at pp. 257-9.
>
> This duty to act in good faith is fundamental to every construction contract. This duty is implied as a matter of law because the intentions of the party play no part in the duty to act in good faith. The duty is assumed.

And at 914 to 916:

[248] 2002 BCSC 1460

[249] Paragraphs 662 to 665

> In *Morrison-Knudsen* and *W.A. Stevenson Construction*, both owners maintained a rigid completion date notwithstanding the fact that it was their delays which would ordinarily have entitled the contractor to extensions in time. In both, the owners required the contractors to meet the original contract schedule without expressly referring to acceleration and the owners were required to indemnify the contractors for the costs the contractors incurred in applying more equipment and personnel in order to speed up the completion of the contract. In *W.A. Stevenson Construction*, the Court found that the owner did not provide the clear work space called for in the contract, failed to provide time extensions the general contractor was entitled to, and found that the conditions of work delayed the execution of the contractor's work including owner-caused delay and weather.
>
> General Condition 36.5 refers to compensation "for the accelerated *parts* for the work" (Emphasis added). Acceleration of parts of the Work is sufficient to trigger an obligation to compensate Golden Hill for the application of more resources in order to allow parts of the Work to be completed earlier than there otherwise would be under the extended Amended Schedule. Had Kemess not required Golden Hill to work despite unsatisfactory conditions and to apply additional resources to the Project, the Project would undoubtedly taken even longer to complete.
>
> I am satisfied that there has been both actual acceleration and constructive acceleration. Kemess ordered Golden Hill to recover time lost as a result of delays not caused by Golden Hill in order to complete parts of the Work before the contemplated extended date for the completion of that particular part of the Work. I am also satisfied that there has been constructive acceleration as Kemess did not accept that matters beyond the control of Golden Hill should result in more time being available to Golden Hill to complete that part of the Work."

Duncan Wallace (1995) suggested[250] that the constructive acceleration doctrine was not founded on any consensual or quasi-contractual basis that would be acceptable in Commonwealth Courts. From the cases noted above, it seems this remains an accurate reflection of judicial attitudes in Canada, or British Columbia province at least, evidenced by a requirement for a direct express order to accelerate in cases where claims are founded upon the US doctrine: see *Emil Andersen* and *Foundation* above.

It is suggested, from analysis of case law above, that several bases for recovery of indirect acceleration have been tested before the Canadian Courts and offer some guide as to the areas upon which a claim might be soundly based:

---

[250] At page 909.

- Fundamental breach: The basis of the decision in *Morrison-Knudson* and *WA Stevenson* were fundamental breach and anticipatory breach respectively. The decisive point in these cases, it is suggested, was the clear evidence that the employer's reluctance to award an extension of time was not temporary, pending receipt of more information for example, but was apparently permanent and final. Hence, these cases deal with refusal to use the extension provisions at all, rather than mere issues of judgement, evidencing a breach of a duty to consider extensions made. Indeed, it is suggested that these cases lend no support at all to acceptance of the constructive acceleration doctrine: they are merely an application of damages paid consequent upon the employer's clear and obvious breach of an express obligation to consider the possible award of an extension.

- Constructive acceleration: The decision in *Emil Anderson* involved consideration of the doctrine, but does not necessarily point to its acceptance. The suggestion is made by Bates (2001)[251] that *Emil Anderson* and *Foundation* are together persuasive authorities as indicating the Canadian courts potentially accepting the constructive acceleration doctrine. Much of the claim in *Foundation* was founded upon alleged oral instructions to accelerate, the decision revolved more around whether instructions had been made rather than the constructive aspect. Brenner J's analysis in *Foundation*, requiring an <u>express</u> instruction from the employer before awarding relief, suggests that these may be less persuasive than thought.

- Mitigation: Under *BG Checo*, followed in *Foundation*, there is now support for recovery of acceleration costs on the basis that is an 'impact cost' or mitigation cost incurred as a reasonable response to the delays. This, it is suggested, is a significant development. Its basis is explored further in later sections of this thesis.

The similarities between the *Perini* decision in Australia, and *Morrision-Knudsen* and *WA* Stevenson referred to above in this regard will be immediately evident. These approaches are fundamentally different to the US position. All of this suggests that a claim to recovery acceleration costs might legitimately be founded upon breach of a term without any reference to the US-based constructive doctrine, or possibly as mitigation cost.

E. The doctrine under English law

So far as can be determined, no reported decisions in UK Courts are available dealing directly with claims advanced under the constructive acceleration doctrine. It appears there are mixed views between commentators in UK that a claim based directly upon the US doctrine would not succeed under English Law. Atkinson (1997) is clearly of the view that a constructive acceleration claim "will not apply in English law".[252] Duncan Wallace (1996) refers to the constructive acceleration doctrine as:

> "a development of what, in any event, is largely a jurisdictional and fictitious doctrine of 'constructive change orders' (CCOs) developed by the Board of Contract Appeals and is not founded on any consensual or quasi contractual basis which would be acceptable in English or Commonwealth Courts"[253]

Winter (2002)[254] suggests that an acceleration claim might succeed if the claimant can prove that there was an express term that was breached by the employer, and that the loss arose from the breach. Pickavance (2000), on the other hand, argues in favour of the doctrine's application outside US. Giving his view, he says:

> "...the doctrine of constructive acceleration provides a more realistic formula for applying the terms of a contract to the demands of a site and the conditions under which the construction industry is forced to work. All in all, it forces contractual interpretation to concentrate on the business efficacy of an arrangement instead of relying on the courts' ability to interpolate outmoded and obviously unsatisfactory doctrines of classical contract theory."[255]

More recently, Lane (2000) argues that a claim may succeed where the employer has ratified the certifier's unauthorised acts.[256] Tweeddale (2004) does not give a view, but highlights that an award was recently made in *Motherwell Bridge Construction Ltd v. Micafil Vacuumtechnik* and Anor[257] on facts consistent with constructive acceleration but without reference to the underlying basis of the award.

---

[251] At page 22.

[252] Lecture notes, page 3.

[253] Hudson's Building Contracts, 11th Edition page 908

[254] This was a short briefing note prepared by Winter and issued by Baker & McKenzie.

[255] Paragraph 9.136.

[256] At 236 – 237.

[257] [2002] All E.R. (D) 159; [2002] C~ILL 1913; [2002] 81 ConLR 44.

Proper evaluation of the doctrine under English law deserves analysis of two aspects of the doctrine: the use of the 'constructive' device; and the so-called 'breach' aspects.

Constructive element.

Constructive change orders, as was noted above, were developed by the Boards of Contract Appeal to retain evaluation of non-compliant change orders within its limited jurisdiction and avoid the need for parties to pursue claims elsewhere. The 'constructive' aspect was a mere jurisdictional invention.

Use of the 'constructive' device was also to be found in Board's consideration of other provisions. In 1948 the Army Board of Contract Appeals held in its decision on the appeal of *Guerin Bros.*[258] that even though the contracting officer did not issue an affirmative suspension order, if the fact were such that an order should have been issued, the board would hold that to be done which should have been done and order an equitable adjustment in any event (what later was termed the doctrine of constructive suspension of work). This decision was a landmark with respect to suspension orders at the time as it demonstrated that the suspension clause could be used to provide an administrative remedy under the contract (that is to say, one within the board's jurisdiction) whereas hitherto boards had rejected similar claims on similar facts. Later, the doctrine of constructive termination was used to distinguish termination for cause and termination for convenience. The constructive device has also been used in the context of approvals that might have been but were not in fact made.[259]

Simon (1988) noted[260] that the constructive change doctrine was still used commonly in federal contracts, that it is a composite of the various arguments of waiver and estoppel to the formal requirements of a change order, and was difficult to sustain. In explaining the concept in *Industrial Research Associates Inc.*[261] the board (in 1968) said:

> The constructive change doctrine is made up of two elements – the "change"

---

[258] WDBCA 1551 (1948)

[259] *See Sylvania* "all circumstances do spell out a constructive approval; action, in short, 'equivalent to an order' (citing Carroll Services Inc., ASBCA Nos 8362 and 8363, 64 BCA 4365).

[260] Page 268

[261] 68-1 BCA (CCH) 7069 (DCAB 1968)

> element and the "order" element. To find the change element we must examine the actual performance to see whether it went beyond the minimum standards demanded by the terms of the contact. But this is not the end of the matter. The "order" element also is a necessary ingredient in the constructive change concept. To be compensable under the changes clause the change must be one that the Government ordered the contractor to make. The government's representative by his words or deeds must require the contractor to perform work which is not a necessary part of the contract. This is something which differs from advice, comments, suggestions, or opinions which government engineering or technical personnel frequently offer to a contractor's employees[262].

This confirms that the constructive element is not intended to address the substance of the change; it addresses the lack of form[263] in which it is made within the context only of federal contracts and their dispute resolution mechanisms. Hence, it is primarily used in US to find liability for oral requests when the contract provides alone for requests in writing, either on a 'constructive' or waiver basis.

According to Birks (1991)[264] the word 'constructive' implies 'deemed' or 'fictitious'. Its use in English law seems limited to the law of trusts and some defined areas, such as employment (where 'constructive dismissal' is well known, for example). Constructive trusts are defined as a trust imposed by operation of law as contrasted with one created by the intention of the party express or implied. As was noted in the Supreme Court of Canada: "The constructive trust comprehends the imposition of trust machinery by the Court in order to achieve a result consonant with good conscience" per Dickson J.[265] Under contract law the imposition of quasi-contract remedies (or restitutionary remedies as they are now known), which were imposed by the courts were analogous. The law of restitution has developed in recent years without 'constructive' doctrines.

How relevant then is the 'constructive' aspect to UK? As no separate public law jurisdictional issues arise, there is little reason to see why parties might want to rely upon the constructive fictional device in the way that has been necessary in US. The leading case in UK supporting

---

262 *Ibid* at 32,685-86.

263 See Hudson, 11th Edition, para 7.004 at page 879 and para 7.070.

264 P Birks, (1991) "In defence of Free Acceptance" in Burrows (ed.) Essays on the Law of Restitution, at page 129.

265 Rathwell v. Rathwell (1978) 83 DLR (3d) 289

the 'constructive' aspect is the Privy Council's decision in *Brodie v Corporation*[266]. The question raised by the appeal was whether it was competent for the arbitrator to award any sum to be paid by the corporation to the contractor for extra work done and material supplied by hgim in the construction of the reservoir, notwithstanding that such extra work and material were not ordered in writing and claimed for in writing as expressly stipulated in the contract. The majority held that the arbitrator did have power. Lord Finlay LC said that "the finding of the arbitrator is to take the place of the order in writing which ought to have been given". Lord Atkinson said "the real dispute between the parties which was referred to the arbitrator ... was whether or not the contractor should under the circumstances be paid for the work he in fact executed". Both approaches differ signficantly from the constructive basis used in US. Further, and in any event, were such issues before an English tribunal today, the claimant would be more likely to rely upon waiver as explaining the absence of form. Alternatively, if it were argued that provision of oral instructions was outside the authority of the consultant the claim would undoubtedly be put on the more modern resitutionary basis. This means that reliance on arguments founded on the 'constructive' element is not necessary for recovery in UK. Instead in UK parties might alternatively rely upon a variety of devices, such as a separate agreement in quasi-contract. These are considered later.

F. Delayed or refused time awards

In order to found the claim on a basis that might be acceptable under English law, much interest has been expressed in founding a claim for damages based on breach, that is to say breach by the architect to award an extension of time, following the decision in *Perini v. Commonwealth of Australia*. Both the timing of extension of time awards and the breach aspect are dealt with here.

The root of the problem, as Keating notes, is "the nature of the temporary 'default' where the contractor is in delay and has not yet been granted an extension of time".[267]

[266] [1919] A.C. 337

[267] Keating, page 1034; See also *Kaye v. Hosier* where Lord Diplock referred to "temporary disconformity".

The Refusal to grant extensions – US position

The refusal or failure to grant an extension of time within a reasonable time has always been a core requirement, implicitly or explicitly, of the constructive acceleration doctrine. In *Standard Store Equipment* the failure to provide an extension, although not specifically mentioned, allowed the board to say that an order to accelerate had effectively been issued. The board did not comment per se on the failure there to issue an extension.

Three Supreme Court decisions dealt specifically with the issue of government failure:

> *Crook v. United States*:[268] The plaintiff plumbing contractor agreed to install installations in two buildings to be erected by a general contractor for the government. The general contractor's works were late by almost a year and the plaintiff sued for damages for delay. In refusing relief, the Supreme Court, through Mr Justice Holmes, noted that the contract did not set hard and fast dates and that it did give the contractor a remedy, a time extension.
>
> *United States* v. *Rice*:[269] This case also involved a delay in making the site available. Even though the decision seemed to turn on the right to delay in making changes, the court noted that the tenor of the contract language left the dates for having the building ready flexible.
>
> In *US v. Howard P Foley*[270] the contractor was awarded the contract to complete the lighting facilities for the runways of Washington National Airport within 120 days. Late availability of the runways resulted in delays to completion. Again the Court of Claims awarded delay costs which the Supreme Court reversed. *Crook* and *Rice* were found to be controlling: the government had not warranted it would make the runways available or that the contract would not be delayed. The delay damages article in the agreement provided a contractual remedy for a government caused delay (a time extension) and the Government had not been negligent. In the absence of a

[268] (1926) 270 U.S. 4

[269] (1942) 317 U.S. 61

[270] (1945) 329 U.S. 64

warranty as to availability on certain dates, the government was not liable.

The approach in each of these cases presupposed reasonable conduct on the part of the government and in every instance the Supreme Court was very careful to point out that no evidence of government negligence or wrong doing was involved. Thereafter in a series of decisions subsequent to *Rice* and *Foley* the Court of Claims made it very clear that when delays resulted from unreasonable conduct on the part of the government in derogation of the contractor's basic entitlement to reasonable government conduct, the contractor could recover in the courts for a breach of contract.

> In *George A Fuller v. United States* the court of claims put a reasonable interpretation on *Foley*. There the government delayed the contractor six months by failing to deliver certain models on time. The court of Claims held the language of the delays-damage article providing for time extensions did not give the government a carte blanche to delay the contract by an action which prevents performance. The government was found to have implicitly warranted that it would furnish models as soon as the contractor need. Accordingly unless the delay is beyond the control and without fault or negligence of the government it must pay the costs incidental thereto.

> In *Electronic & Missile Facilities*, the board noted (in 1964) "there was no justification for the government taking so long in granting the contractor a time extension to which it was entitled for unusually severe weather. ... The government went beyond a refusal to process requests for time extensions and by its actions and course of conduct required appellant to adhere to the original progress schedule.

The net effect of these cases as seen by the Court of Claims was that government-caused delays subsisted with the implied duty of the government to cooperate and not to hinder performance. That expectation was extended to cover administrative functions, and in particular the time taken to award extensions of time.

The Refusal to grant extensions – position under English law

The refusal or failure to grant an extension of time within a reasonable time within UK has for long been an area of contention. It raises the question: just how quickly should an extension be awarded? The first half of the 19th Century saw the development of lump sum contracting in UK and with it obligations to complete the work by stipulated dates. Provisions, in time, were made for forfeiture of sums on failure to completion by the date for completion. Since the mid-19th Century parties have sought to avoid liability for such liquidated sums. In time, three grounds have emerged to avoid liability where work has been delayed by an act of prevention on the employer's part. The first is absence of an extension of time provision. Second is drafting of the extension of time provision that was not sufficiently wide to cover the delaying or preventing act. The third basis evident from reports throughout the commonwealth upon which recovery of liquidated damages has been denied is where, in the view of the court, the power to award an extension of time was not properly exercised. Thus, this is not concerned with the scope of the extension of time clause but with its application. The issue continues to arise today particularly where there is a failure to award time within an express time period or where there is obvious procrastination or interference in the awarding process. It is this third basis that is of interest here.

Several authors and commentators, particularly Pickavance (2000), say that a contract administrator should act as soon as possible with the award of an extension of time[271] and suggest that "in the absence of an extension promptly made on due notice, once the contractor has accelerated the works, the Employer no longer has any choice and can only be liable for the costs of the acceleration, whether the relevant event was compensable or not.[272] He relies for that proposition on the decision of Macfarlan J in *Perini Corporation v. Commonwealth of Australia*.

The decision in *Perini* is of some interest. The case was heard on a preliminary point only, with three main issues: the independence[273] of the certifier; whether there was an implied term that the engineer would act independently of the employer; and the timing within which an award might be made. The contract in question was somewhat unusual also, for time was said to be of the essence. The fundamental basis upon which the plaintiff proceeded against the defendant was that the defendant was in breach of certain terms implied in the agreement. It was claimed that extensions of time had to be made promptly for in the case of any

[271] Paragraph 4.85

[272] At 4.92

[273] It was said that as the engineer was an employee, he was not independent and failed to show impartiality.

procrastination resources had to be redeployed to attempt to meet the contracted for date of completion. Macfarlan J said:

> "I do not quite appreciate how condition 35 can be construed as an obligation to decide promptly, but I am clear that both the exigencies of this agreement as well as the words of clause 35 require that the decision must be given with a reasonable time. That measurement of reasonable time in any particular case is always a matter of fact... Plainly the director must not delay, nor may he procrastinate, and in my opinion he is not entitled simply to defer a decision. On the other hand he is, in my opinion, and this follows from the nature of his obligation to give his own personal decision on the point, necessarily obliged to have available for that consideration such time was is necessary to enable him to investigate the facts which are relevant to making it. When that investigation is complete I am of the opinion that his decision should then be made."[274]

Pickavance's argument is based upon the above passage, particularly the last line.

It might equally be argued that an expectation that an extension of time award is made promptly is, at best, ambitious, whether on the basis of Macfarlan J's decision or otherwise. What if the certifier finds he does not have sufficient facts available, or (as commonly occurs) says he is awaiting further facts from the contractor to enable him to make the decision? If the conditions require an extension on the basis of the actual delay incurred, he may have to delay until at least completion of the works to ascertain what the delay due to one or more particular events in fact was. It is submitted that the architect might only form a view when continuing causes of delay have ceased or when confusion over competing causes is cleared. This is also consistent with Macfarlan J's reference to the need for 'such time as is necessary to enable him to investigate the facts'. That might only be well after completion of the works. All of this suggests, it is submitted, that the prospect of establishing that a time award should be made promptly may be rarely achieved on the facts. Establishing that decision-making has been unreasonably delayed (as Pickavance would seemingly require) seems difficult to achieve, if not far fetched, in the absence of some direct evidence of delay in decision making unconnected with availability of data. This also means that the contractor cannot expect an entitlement to accrue before a decision on an extension was otherwise due.

The better view, it is suggested, is provided by Duncan Wallace in *Hudson*. The updated 10th

[274] At 102. The conclusion was repeated at 112.

edition of *Hudson* was published in late 1970, soon after the *Peak* decision.[275] The summary was changed considerably in the 10th Edition in 1970, largely in the light of *Amalgamated*, to read as follows:

> "There are, it is suggested, three possible constructions of extension of time clauses in so far as the item for exercise of the power is concerned. In the first place, the contact may contemplate that the power should be exercised at once upon the occurrence of the event causing delay. This construction may be appropriate to non-continuing causes of delays, such as the ordering of extras. Secondly the contract may contemplate that the power should be exercised when the full effect upon the contract programme is known. This is appropriate to continuing causes of delay, such as strikes, withholding of the site, and so on, or to cases like some extras, where precise estimation is difficult or impossible. Or, thirdly, the contract may contemplate exercise of the power at any time before issue of the final certificate. Since the case of *Amalgamated*, a decision on the then current RIBA form of contract, which distinguished *Miller* on somewhat slender grounds, it is suggested that this latter interpretation will normally prevail in the absence of clear language to the contrary, particularly as the ambit of most modern extension of time clauses usually comprehends delays due to causes of many different kinds." [276]

Once published, the revised commentary in the 10th Edition of *Hudson* was judicially followed. In *New Zealand Structures & Investments* v. *McKenzie*[277] the plaintiff contractor started work late due to delays in demolishing an existing building, with the result that work had to be carried out during the winter rather than the summer period. Work was partially completed on 26 July 1976, over a year late, and substantially completed on 7 December 1976. On 1 March 1977 an extension of time was issued retrospectively to 30 April 1976. The contractor challenged the extension on the basis that it was issued too late. Casey J decided that the Engineer could grant an extension of time at any time up to the stage when he became functus officio and was not limited by the completion date in the contract. He adopted the reasoning in *Amalgamated Building,* cited with approval the revised summary in *Hudson*'s 10th Edition and added:

> "The reasoning in [*Anderson* and *Miller*] ... suggest that the time had to be fixed before completion date so that the contractor could know his new date in order to achieve it. ... In modern building practice [extension of time] clauses

275 Indeed, it contained several footnote references to Peak. The author, I N Duncan Wallace, was well placed to comment on progress of the law in this area, for he had appeared as junior counsel in *Peak*.

276 Pp 644-645

277 1 NZLR 515

> are not generally used for this purpose; their function is to enable a date to be fixed for the calculation of damages for delay – liquidated or otherwise. As this case so clearly demonstrates, in a major contract it is virtually impossible to gauge the effect of any one cause of delay while it is still proceeding, let alone assess the consequences of concurrent or overlapping causes. Finally, any need to have a prompt decision loses some force as a factor in interpreting such a clause when one considers the normal review and arbitration proceedings, which can take a decision well beyond the final certificate date."[278]

In *Fernbrook Trading Ltd v. Taggart* Roper J, after a review of the law in *Anderson, Miller, MacMahon, Amalgamated, Hudson*'s 10th Edition and *New Zealand Structures*, endorsed the view in *Hudson* and summarised the law as follows:

> "In my opinion no one rule of construction to cover all the circumstances can be postulated and the best that can be said on the present state of the authorities is that whether the completion date is set at large by a delay in granting an extension must depend upon the particular circumstances pertaining.
>
> I think it must be implicit in the normal extension clause that the contractor is to be informed of his new completion date as soon as is reasonably practicable. If the sole cause is the ordering of extra work then in the normal course the extension should be given at the time of the ordering so that the contract has a target for which to aim. Where the cause of delay lies beyond the employer, and particularly where its duration is uncertain then the extension order may be delayed, although even there it would be a reasonable inference to draw from the ordinary extension clause that the extension should be given a reasonable time after the factors which will govern the exercise of the Engineer's discretion have been established. Where there are multiple causes of delay there may be no alternative but to leave the final decision until just before the issue of the final certificate." [279]

Denning J's decision in *Amalgamated* was endorsed and followed in 1993 in *Balfour Beatty v. Chestermount Properties*. The issue before the Court was whether the extension awarded, where the relevant event occurs whilst the contractor is in culpable delay, should be awarded on a gross basis or net basis. On a gross basis the period of extension is the entire period since the date for completion to the date the work was done, whereas the nett period was merely time consumed by the impact of the relevant event, ignoring any culpable delay. This was in fact a modern formulation of the question whether the architect was empowered to issue extensions retrospectively. Coleman J confirmed (following *Amalgamated*) that there was

278 ibid, at 540-541.

279 Per Roper J at 568.

nothing invalid about award of an extension after the date for completion was passed. After a broad analysis of the function and operation of time-related provisions he noted:

> "The underlying objective is to arrive at the aggregate period of time within which the contract works as ultimately defined ought to have been completed having regard to the incidence of non-contractor's risk event and to calculate the excess time if any, over the period, which the contractor took to complete the works. ...the contract is not ambiguous or so unclear as to call for application of the contra proferentem rule or the resolution of the nicely-balanced issues of construction[[280]] in favour of the employers for whose benefit the liquidated damages regime is introduced. The apparently anomalous consequence of the application of the arbitrator's construction that the architect could refix a completion date before the issue of the variation instruction is in my view entirely consistent with the basic purpose of the liquidated damages regime ... the retrospective postponement of the completion date to a date before the event causing delay was an eventuality contemplated with equanimity by Lord Denning MR in *Amalgamated*."

In summary, Colman J explained why the architect was empowered to issue extensions retrospectively and endorsed Denning's views in *Amalgamated.* He added:

> "In view of the inherent difficulties in predicting with precision the impact on the progress of the works of non-contractor's risk events, particularly when operating simultaneously with contractor's risk events the architect is given a power of retrospective adjustment of the completion date."

These comments appear to support the view in *Hudson* that the contract may contemplate exercise of the power to issue an extension of time at any time before issue of the final certificate (as opposed to the power being exercised at once upon the occurrence of the event causing delay) and that this view will normally prevail.

The final judgment of note here is *Hawl-Mac Construction* v. *Campbell River*, a decision of the British Columbia Supreme Court. Giving judgment for the plaintiff contractor, the court found that the contract required the engineer to consider an application for an extension of time upon receiving it and to fix a time for extension. Having failed to perform that obligation before the original time for completion of the contract expired, there was no longer a specific date within which the contract was to be completed or from which penalties could be deducted.

Hawl-Mac, in the face of *Amalgamated et seq* is clearly an anomalous decision. The extension of time clause provided:

> "If the contractor is delayed in the completion of the Work by the owner, engineer... then the time of completion *shall* be extended ... the Engineer, upon receipt of his written claim, *shall* fully and fairly consider it and fix such an extension period (if any) as in his sole discretion is fair and reasonable in the circumstances. [emphasis added]

It appears that Wallace J took the view that the extension had to be granted, on a construction of the clause, immediately upon receipt of a claim. In fact was 1981. On 8th October the contractor sought an extension of time. By 4th December 1981, the date for completion, the engineer had not yet replied, and only replied on 29 January 1982, when he granted an extension to 11 January 1982. Wallace J's decision was based on the engineer's failure to reply immediately, or at any rate before the date *for* completion, following both *Anderson* and *Miller*. The best explanation of the decision may be that *Amalgamated* and the relevant passage of *Hudson*'s 10th Edition were not drawn to Wallace J's attention. It is suggested that it is unlikely the this decision would be followed today were the same matter to come before the English Courts.

Hawl-Mac was referred to two later Canadian decisions: in *Dilcon v. British Colombia Hydro & Power Authority* (1992), where, on the facts, it was not followed; and in *AL Sims & Sons v. City of Prince George* (2001) without comment

In *Dilcon*, the plaintiff submited that Hydro could not rely upon the final Completion Date for the purpose of claiming damages because it had not been determined within the tenure of the Contract. The Contract did not require the Chief Engineer to make his Rulings with respect to time extensions within any specified period of time. Indeed, the relevant extensions of time could not be calculated until the Contractor's claims were determined, and Dillingham repeatedly requested Hydro to defer referring those claims to the Chief Engineer in order to attempt settlement of those claims. The settlement negotiations continued until November 1988, two *months* after the Work was completed. In those circumstances, he found that even if there was an implied term of the Contract that required the Chief Engineer to determine

280 This appears to be a reference to the earlier cases, such as Anderson and Miller where the contra proferentem rule was relied upon and which involved finely balanced construction of clauses.

extensions to the Mandatory Completion Dates prior to the end of construction, or at some other time, that term was waived by the parties.

So what conclusions can be drawn with regard to the limited question, discussed here, as to how quickly extensions of time should be granted? There has until recently been an underlying tension in the award of extensions between giving an extension award promptly so as to give the contractor a date for which to aim on the one hand, and allowing sufficient time to make a precise calculation of the award due in the face of an array of differing facts and causes. Before 1952 the courts tended to invalidate any attempt to recover liquidated damages where extensions were not given before the expiry of the date for completion, so as to give contractors a date for which to aim. The view of the courts has now changed, following Denning J's decision in *Amalgamated*, publication of the 10th Edition of *Hudson* and *Balfour Beatty* decision The present position appears to be that, in the absence of a provision that expressly requires a decision within a particular period, an award need only be made after the certifier is in a position to disentangle the various competing causes. Accordingly, in any case where an acceleration claim is founded upon a failure to award an extension, the prospect for showing failure to deal fairly and expeditiously with the award will only lie in exceptional circumstances, such as where the employer evinces a disregard entirely for the extension of time machinery.

Many US decisions were formed on the basis of delay during the project in evaluating time claims. The apparently different approach taken by an English court makes support for the constructive acceleration doctrine most unlikely.

The comments of Macfarlan J in *Perini* were made seemingly on first principles. Within two years of that decision a developed and considered summary of the law was set out in the 10th edition of *Hudson*. The view taken there, with which subsequent caselaw is consistent, is that the obligation to evaluate extensions of time within a reasonable period will be probably limited by available data. It may be that the entire contract period is required to determine the extension required, or the decision may even by made after the contract period. Pickavance's suggestion, based upon comments in *Perini*, that an award should be made soon after a delay is incurred accordingly therefore appears to have been advanced upon a position now overtaken by later decisions, and by the views of *Hudson*.

Pickavance's further point was that the failure to deal promptly with the extension sounds in damages, and that the damages are acceleration costs, if incurred. This point appears misguided. If, upon analysis, the architect was not in a position to make a proper evaluation until completion of the work, and failed to make any evaluation for a further year, it would seem a non-sequitur to suggest that the contractor had incurred acceleration expenses at any time before that proper evaluation could be made. On this basis, Pickavance's suggested basis for pursuit of a claim based upon a breach has little support or merit.

An observation made repeatedly, principally by Pickavance (2000), is that late evaluation of time claims is unfair, leaving the contractor in a position where he does not know the extent of time that might be awarded.[281] A number of comments might usefully be made going the other way. First, since 1952, the position under English law is that the purpose of the Eot clause is not to set targets, but to set a date from which damages may be deducted.[282] Second, the validity of this point was strongest in the past when evaluation of time due seemed a matter of great uncertainty, perhaps reflecting the somewhat superficial approach to evaluation seen on some projects.[283] But as principles for evaluation by employers have developed so also has a contractor's capacity to review progress to date and establish detailed views on time matters. With the benefit of such analysis during the project the contractor might decide, upon that data, what actions to take. Third, it has long been the tradition in UK for work to be carried out pursuant to oral instructions. This can leave the contractor in the position of having done the work but not aware as to whether or how much he might be paid for the work; it may be that no sum is due at all if confirming an existing specification. Arguably an oral instruction to accelerate is no different in that a contractor might equally not expect to know its true contractual position until established.

The Breach element.

As noted above, several commentators in UK have taken the view that for a claim to be pursued successfully before the English courts would require the claimant to show a breach in the process of making time awards, a breach that leads to damages. It is thought that the

[281] Paragraph 4.85

[282] *Amalgamated Building Contractors v. Waltham* UDC [1952] 2 All E.R. 452.

[283] See for example *John Barker v. London Portman Hotels* (1996) 83 BLR 1 for a description of this.

breach is necessary to found liability in English law. This in turn has lead to considerable debate over the exact formulation of the term, express or implied, that must be found. Hence, many views are provided on *Perini*, being one of very few cases dealing with the type of term that might be implied. Whether a breach-based approach is necessary or desirable is questionable. It is instructive to re-examine elements of the US doctrine.

It is an absolute prerequisite to an acceleration calm in US that the contractor be able to show the existence of an express or implied acceleration order. Otherwise the contractor will be held to be a mere volunteer. A claim made does not necessarily require the contractor to show that a request for an extension was made. This may be excused if the information was already available to the defendant[284] Some examples of non-orders may be instructive. It has been held that a mere failure by a contracting officer to act on a request for time extension by itself, does not constitute an acceleration order.[285] Similarly mere expressions of concern by government represented that the contact is falling behind schedule are not sufficient to constitute acceleration orders. Reasonable pressure on a contractor to get contract work done within the scheduled time is not, by itself, an acceleration order.[286]

The boards and courts are likely to find an implied acceleration order where the government combines a refusal of a reasonable request for a time extension for an excusable delay with a demand that the contract complete (or submit plans showing how he will complete) the work within the original contract term, and threatens the assessment of liquidated damages (or termination) for late completion: *Norair*. If, in addition, the government actually assesses liquidated damages, the contractor's claim is so much the stronger.

It is notable that breach on the part of the contract administrator or employer is not a necessary condition for a constructive acceleration award in US. This, it is thought, is because acceleration may be required in any event by the employer independent of delays incurred.

Some commentators have found support for the breach-based approach in *Hudson*. There it is

---

[284] *Fermont Division, Dynamics Corp*, 75-1 BCA (CCH) 11,139; *Carroll Serv, Inc.*, 67-2 BCA (CCH) 4365 (1964) ; Aero Corp.

[285] *Nello L Teer Co. v. Washington Metro. Area Transit Authority*, 695 F. Supp. 583, DDC (1988); *Norair Engineering Corporation v. United Station*, 229 Ct. Cl. 160, 666 F. 2d 546 (Ct Cl 1981)

[286] *Fermont Div, Dynamic Corp. of America*, ASBCA No. 15,806, 75-1 BCA (CCH)

noted at 10.079:[287]

> "Thus it has been seen that express refusal or continued failure to deal promptly with an extension of time application on the part of the A/E, as in all matters requiring certification, can absolve the party concerned of the necessity of obtaining the certificate or extension, as well as constituting a breach of contract sounding in damages."

It is possible that this passage has been misinterpreted. Before this passage it was noted that an extension of time award can be set aside if it is shown that the power to award time was not properly exercised, a power that can appear draconian. It is drafted in the context of permitting recovery of damages for late receipt of an award in view of setting aside the entire damages provision. It is not intended, it is submitted, that a finding of breach is a necessary part of a claim however.

If breach based, then claims will be made upon the Architect or Engineer's failure to certify. Proof of breaches with respect to certification of values is difficult to sustain. Proof that the supervising officer is in breach for failure to grant the appropriate extension at the appropriate time will be next to impossible. In any case where there is evidence of concurrent cause, doubt with respect to responsibility for delays, or lack of difficulty complained of impacted critical activities, proof of breach may be very difficult to sustain.

What leads to acceleration is not the failure to certify but the categorical statement that the original date for completion would be maintained. It is the prospect of liability for liquidated damages, liability that influences significantly the project costs and which might be avoided, that drives acceleration. Restatement of the original date for completion is not a contractual breach. It is either a restatement of the contract's terms or a unilateral variation of the contract's terms. Assuming no contractual basis upon which such a variation can be made, restatement of the original date for completion may be an offer, capable of acceptance by the contractor's change in position evidence by a changed approach to management of the project away from what would otherwise have been acceptable.

For these reasons, it is suggested that a breach based approach, even if supported by UK courts, the prospect for success cannot be expected to be high. Alternative bases for recovery

[287] The point is repeated at 10.089

should be explored.

G. Recovery under bases other than Breach

Lane (2000) commented without consideration of US authorities or of the source of the doctrine. He suggests the doctrine per se has no place but the same factual circumstances can be dealt with in other ways under English law. It appears several bases are available:

- Oral instructions. the oral exchange through which the change is made. This is possible because of the long history of provision, under standard forms in UK for confirmation of oral instructions.

- If oral instructions are not permitted under the agreement with respect to the time for performance, liability might arise from an independent or collateral contract with recover on a quantum meruit basis. Indeed *Hudson* noted[288] that the constructive acceleration doctrine was "not founded upon any consensual or quasi contractual basis which would be acceptable in English or Commonwealth Courts" but does not suggest that recovery is not possible on those bases. Thus, it is submitted that a claim might be founded upon a simple collateral contract where acceleration was clearly requested but price left unresolved: the price would be settled on a quantum meruit basis.

- The alternative basis for recovery may lie in costs incurred in mitigation.

H. Conclusions

UK courts are most unlikely to make awards for implied acceleration instructions where reliance is placed diriectly upon the US developed doctrine of Constructive acceleration. A similar reluctance to make awards on this basis is also evident in Australia and Canada.

Liability on the basis of delayed or untimely extension of time awards are most unlikely to be achieved. A distinction needs to be drawn between delay in time awards due to an honestly

[288] At 7.050

held belief that no further time is due, and an outright refusal to operate the extension of time machinery. It is submitted that it is only on the latter basis that liability is likely to be achieved, in factual situations simiar to those found in *Morrison Knudsen*, *WA Stevenson* or *Perini*.

In the absence of an express instruction to accelerate, recovery of additional costs incurred might be secured through: finding a separate contract, or an action to recover on the basis of restitutionary quantum meruit.

The Courts in Canada are playing a key role in considering and developing law in this area, having considered the constructive acceleration doctrine, mitigation and other bases of recovery. It was also noted that there is judicial support in Canada for recovery under the mitigation rule. This is considered in further detail in the follow chapters.

IX. Defences to acceleration claims

A. A snapshot of defences available

Commentators on acceleration have tended to focus on limited aspects: bases of liability, how claims are developed, and cost. Construction professionals and employers have wide ranging views on how acceleration claims might be handled. Rather than following a particular known path, their views seem to have been drawn from their own experiences. This section aims to contribute to the body of knowledge in this area by drawing together and analysing defences available.

Defences fall into two separate groups. In the first are attempts to avoid or resile from an acceleration agreement made between the parties. Defences here might include any common law defence arguments: that the agreement was voidable due to misrepresenation, fraud or mistake. These are not considered here. Of equal interest, reviewed here first, are the twin defences:

- That the work to be carried out under the agreement was a pre-existing duty and that there is no consideration to support the agreement; and

- That the agreement was entered into under duress and can therefore be avoided.

Defences are put in a factual manner: the costs claimed are not recoverable because they were included in a previous agreement or settlement of other issues. The boldest attack is that the accelerative measures brought no benefit, and that they did not work. Neither is considered here.

In the second category are attempts to avoid alleged or implied instructions to accelerate. Several defences are commonly found:

- Causation based defence: the accelerative actions were caused by the contractors failure to progress the works.This is quasi-factual: "had you not been in delay, acceleration would not have been required". This might alternatively be cited: "the delay was all your fault". This is a comparatively complex area;[289]

- A mitigation defence: if the works are in delay that the accelerative actions were merely taken as part of the contractor's contractual duty to mitigate or avoid delays. This highlights the need to understand contractual and common law duties owed by contractors where acceleration is sought; or

- that contractul formalities necessary for instructions to be effective were lacking.

Further quantum related defences – for example that too much cost has been incurred in accelerating – are also available. These quantum issues are dealt with separately in the next chapter.

Together, there is a view that a myriad of defences can be deployed to cut down any acceleration-based claim. This chapter is concerned with testing these defences within their legal context.

B. The pre-existing duty defence

It is noted from some case studies[290] and decisions[291] that employers, upon finding during the course of the works that progress of work was delayed, agreed to pay additional sums to contractors for timely performance, but subsequently sought to avoid payment when work was completed. Two grounds for refusing to pay were evident. In one, the employer sought to avoid payment on the basis that no time in the event had been saved. The essential argument here was that no value was received. The second defence arose where some delays were recovered, but the employer sought to avoid payment on the basis that the delays were matters

---

289 A well-known defence, and one that can naturally be expected where delay claims have been made, is that the delay was not the fault of the employer at all: delays caused by or incurred on the part of the contractor are matters to be resolved by the contractor. This defence was explored above in Chapter II and is not dealt with further here.

290 National Exhibition Centre; De Montfort University; JP Morgan bank; King's Lynn Power Station; and Sutton Bridge Power Station.

291 Notably *Williams v. Roffey Brothers & Nichols (Contractors) Ltd*

for which the contractor was responsible. The issue, explored here, is whether this is a sound basis to defend a claim by a contractor to recover acceleration costs. The question to be addressed by the court, assuming the contractor in fact caused all delays, is whether the employer is entitled to resile from the promise to pay. At law, the question is whether the promisor's promise to pay is enforceable.

The long held view, under English law, was that performance of a pre-existing duty did not amount to good consideration.[292] Thus, an agreement whereby a contractor was to be paid additional sums for performance of existing contractual obligations was unenforceable.

In *Harris* v. *Watson*,[293] reported in 1791, the Defendant master and commander of the ship promised the plaintiff seaman an additional five guineas over and above his wages to navigate the ship. That promise was made when the ship, bound to Lisbon, was in danger during the voyage. The court's decision was that the plaintiff's action on the promise could not be supported. Lord Keynon said,

> "If this action was to be supported, it would materially affect the navigation of this kingdom. It has been long since determined that when the freight is lost, the wages are also lost. This rule was founded on a principle of policy, for if sailors were in all such events to have their wages, and in times of danger entitled to insist on an extra charge on such a promise as this, they would in many cases suffer a ship to sink, unless the captain would pay any extra extravagant demand they might think proper to make."

Thus, the decision was plainly made on policy grounds. *Stilk* v. *Myrick* was decided in 1809. That case arose out of a return trip to the Baltic. On arrival at Cronstadt, two members of the ship deserted. The master was unable to find replacements, so promised to split the wages of the two members between other crewmembers. Here the promise was made, apparently without coercion, voluntarily for extraordinary service. As in *Harris* v. *Watson*, the court decided that the promise was not enforceable. There are two reports of the case. One, by Espinasse who was junior counsel for the unsuccessful plaintiff in the case, reported Lord Ellenborough as saying that '... he recognised the principle of the case of *Harris* v. *Watson* as founded on just and proper policy', but the report continues 'When the defendant [scienter the

292 *Harris* v. *Watson*; *Stilk v. Myrick* (1809) 2 Camp. 317; 9 AC 605

293 (1791) Peake 102

plaintiff] entered on board the ship, he stipulated to do all the work his situation called upon him to do'. In Campbell's report of the case, taken as the more reliable, Lord Ellenborough said:

> "I think *Harris v.* Watson was rightly decided; but I doubt whether the ground of public policy, upon which Lord Kenyon is stated to have proceeded, be the true principle upon which the decision is to be supported. Here I say agreement is void for want of consideration. ... There is no consideration for the ulterior pay promised to the mariners who remained with the ship. Before they sailed from London they had undertaken to do all that that they could under all the emergencies of the voyage. They sold all their services till the voyage should be completed. ...But the desertion of the crew is to be considered an emergency as much as their death; and those who remain are bound by the terms of the original contract to exert themselves to the upmost to bring the ship in safety to her destined port. Therefore, without looking to the policy of this agreement, I think it is void for want of consideration, and that the plaintiff can only recover at the rate of £5 a month."

Both cases have traditionally been interpreted as explicable on the basis of an absence of fresh consideration for the captain's promise.[294] But the law has "undergone a radical development"[295] as a result of the decision in *Williams v. Roffey Bros & Nicholls (Contractors) Ltd.*[296]

In *Williams* v. *Roffey* the defendant building contractor had agreed to refurbish 27 flats for a housing association. The plaintiff was a carpentry subcontractor, and the subcontract price was £20,000. Payments were made as the work proceeded. By April 1996, the carpentry in only 9 flats had been completed, and work had commenced in all other flats, but he had been paid £16,000. The plaintiff was in financial difficulties, and both parties realised that one reason why this was so was because the subcontract price was too low. The defendants agreed to pay an additional £10,300 at the rate of £575 per completed flat. The plaintiff completed a further eight flats but was only paid an additional £1500, so the plaintiff stopped work and sued. The recorder made an award in his favour and the defendant appealed. The Court of Appeal dismissed the appeal. Russell, Glidewell and Purchas LJJ each suggested that *Stilk* v. *Myrick* did not need to be overruled but suggested a new approach to finding consideration.

---

294 See for example, Lord Scarman speech in *Pao On v. Lau Yiu Long*

295 *Anangel Atlas Compania Naviera SA and others v. Iskikawajima-Hirima Heavy Industries co Ltd (no. 2)* [1990] 2 Lloyd's Rep 526. at 544

296 [1991] 1 QB 1; [1990] 2 WLR 1153

Russell LJ's rationale was that he did not believe that the rigid approach to consideration found in *Stilk* v. *Myrick* was either necessary or desirable in the late twentieth century. He thought the courts should be "more ready to find [consideration] so as to reflect the intention of the parties to the contract where the bargaining powers are not unequal and where the finding of consideration reflects the true intention of the parties". These words seem to echo Lord Scarman's speech in *Pao On*, decided ten years earlier, where he said "...justice requires that men be held to their bargains unless it can be shown that their consent was vitiated by fraud, mistake or duress. If a promise is induced by coercion of a man's will, the doctrine of duress suffices to do justice." After examining the true intention of the parties, Russell LJ found that the work to be done by the plaintiff did not change but the terms upon which the work had been done had changed. That variation was, he suggested, supported by consideration "which a pragmatic approach to the true relationship between the parties readily demonstrates". In that relationship, he found that there were advantages accruing to the defendant (putting on a more formalised footing the payment arrangements and retaining the services of the plaintiff so as to avoid the need to employ another subcontractor) that could fairly be said to be in consideration of their undertaking to pay the additional £10,300. He concluded that he had no reservation over *Stilk* v. *Myrick*. "A gratuitous promise, pure and simple, remains unenforceable unless given under seal. But where, as in this case a party undertakes to make a payment because by so doing it will gain an advantage arising out of the continuing relationship with the promisee the new bargain will not fail for want of consideration."

There appear several reasons to believe that Russell LJ's analysis is unlikely to be followed. To suggest there was unequal bargaining power between the parties looks no further than whether the organisation falls into the categories of business or consumer. In this case, assuming the, the main contractor's position would have been in the stronger negotiating position when work was secured. Later, during the course of the work when the subcontractor ran into financial difficulties, the subcontractor's bargaining position was arguably immense. He could have brought on a new subcontractor, but there would probably have been insufficient time to secure to secure a new subcontractor at an acceptable price level. The main contractor was all but beholden to him, dependant upon him completing timeously, if the main contractor was to avoid liability to damages to the employer. The alternative, changing subcontractor, would have resulted in a delay.

Second, Russell LJ's approach the notion of looking to the intention of the parties sits uncomfortably with Lord Hoffman's dicta in *Investors Compensation Scheme v. West Bromwich Building Society* setting out principles by which contractual documents are to be construed.[297] Third, and more fundamental, Russell LJ's approach makes no mention of duress.

On the facts, Purchas LJ was satisfied that both parties had derived advantages from their commercial arrangement, relying on the passage in *Woodhouse AC Isreal Cocoa Ltd SA* v. *Nigerian Produce Marketing Co Ltd* where Lord Hailsham said "... I imagine that a modern court would have found no difficulty in discovering consideration for such a promise. Businessmen know their own business best, even when they appear to grant an indulgence." Purchas LJ concluded "I consider that the modern approach to the question of consideration would be that where there were benefits derived *by each party* to a contract of variation even though one party did not suffer a detriment this would not be fatal to establishing sufficient consideration to support the agreement. Purchas LJ said "Modern cases tend to rely more on the defence of duress in a commercial context rather than lack of consideration for the second agreement". If both parties benefit from an agreement it is not necessary that each also suffers a detriment." Thus, under the new approach to consideration a practical benefit accruing to the promisor, secured in the absence of duress, will suffice for consideration to be identified.

Glidewell LJ suggested that the doctrine of duress may provide another answer in law to the question of policy which has troubled the courts since before *Stilk v. Myrick*, and no doubt led, at the date of that decision, to a rigid adherence to the doctrine of consideration. He said the present state of the law on this subject could be expressed in the follow proposition:

(i) if A has entered into a contract with B to do work for, or to supply goods or services to, B in return for payment by B, and

(ii) at some stage before A has completely performed his obligations under the contract and has reason to doubt whether A will, or will be able to, complete

[297] Per Lord Hoffmann "The law excludes from the admissible background the previous negotiations of the parties and their declarations of subjective intent. They are admissible only in an action for rectification. The law makes this distinction for reasons of practical policy and, in this respect only, legal interpretation differs from the way we would interpret utterances in ordinary life."

his side of the bargain; and

(iii) B thereupon promises A an additional payment in return for A's promise to perform his contractual obligations on time; and

(iv) As a result of giving his promise, B obtains in practice a benefit, or obviates a disbenefit; and

(v) B's promise is not given as the result of economic duress or fraud on the part of A; then

(vi) The benefit of B is capable of being consideration for B's promise, so that the promise will be legally binding.

Despite the three different approaches adopted in the three speeches in *Williams* v. *Roffey*, there was some uniformity between them as to how the answer achieved could reconciled with *Harris* v. *Watson* and *Stilk* v. *Myrick*. Each accepted that *Stilk* v. *Myrick* remained good law. Glidewell LJ, dealing with the point directly, said "if it be objected that the propositions above contravene the principle in *Stilk* v. *Myrick*, I answer that in my view they do not; they refine and limit the application of that principle, but they leave the principle unscathed, eg where B secures no benefit by his promise. It is not in my view surprising that a principle enunciated in relation to the rigours of seafaring life during the Napoleonic wars should be subjected during the succeeding 180 years to a process of refinement and limitation in its application in the present day." Similarly Russell LJ said "The two cases *Harris* v. *Watson* and *Stilk* v. *Myrick* involved circumstances of a very special nature, namely the extraordinary conditions existing at the turn of the eighteenth century under which seamen had to serve their contracts of employment on the high seas. There were strong public policy grounds at that time to protect the master and owners of a ship from being held to ransom by disaffected crews. Thus, the decision that the promise to pay extra wages even in the circumstances established in those cases, was not supported by consideration is readily understandable. Of course conditions today on the high seas have changed dramatically and it is at least questionable, as Mr Makey submitted, whether those cases might not well have been decided differently if they were tried today."

The impact of *Williams v. Roffey*, put shortly, is that the employer will not be able to avoid payments promised where some practical benefit is found to have accrued. *Williams v. Roffey* has been cited with approval and followed in courts in England[298] and Australia.[299] In *Musumeci v. Winadell Pty Ltd*[300] Santow J adopted the reasoning of Glidewell J and suggested enhancements to his test. These additional points have yet to be tested before the English courts.

It is now clear that Glidewell's proposition, introducing both 'practical benefit' and duress, is becoming the basis upon which contract modifications are enforced by courts, in lieu of a detailed search for consideration. *Williams* was followed in two subsequent cases, *The Alev*, and *Anangel Atlas Com. Nav. SA* v. *Ishikawajima-Harima Heavy Industries Co. Ltd. (No. 2)*. Colman J's recent criticism[301] of the entire rationale of *Williams* is notable, but has yet to be noted or discussed by other courts. He only followed it because it was a binding precedent set by the Court of Appeal.

Williams v. Roffey was not followed in *Re Selectmove*.[302] In that case, which was concerned with payment of a debt, the Court of Appeal declared it was obliged by precedent to follow the earlier House of Lords decision in *Foakes* v. *Beer*, which was concerned with an accommodation to pay a lesser sum in lieu of a debt. The House of Lords decided that such an agreement was not enforceable, following *Pinnel's case*. The rule in *Pinnel's Case*, stated by Sir Edward Coke to have been laid down by all the judges of the Common Pleas in 1602, was "that payment of a lesser sum on the day in satisfaction of a greater cannot be any substitution for the whole, because it appears to the judges that by no possibility a lesser sum can be satisfaction to the plaintiff for a greater sum; but the gift of a horse, a hawk, or robe might be more beneficial to the plaintiff than the money in respect of some circumstance, or otherwise the plaintiff would not have accepted of it in satisfaction. But where the whole sum is due, by

---

298 *Lee v. GEC Plessey Telecommunications* [1993] IRLR 383; *Simon Container Machinery Ltd v. EMBA Machinery AB* [1998] 2 Lloyd's Rep 429; Although the facts are similar in *B&S Contracts and Design Ltd v. Victor Green Publications Ltd.* no mention was made in the report of *Williams v. Roffey*, as duress was pleaded. See also *Westminister Building Company v. Beckingham* [2004] EWHC 138 (TCC)

299 *Dynevor P/L v. Proprietors, Centrepoint Building Units* [1995] QCA 166 (12 May 1995); *Evans Deakin Pty Ltd v. Sebel Furniture Ltd* [2003] FCA 171 (12 March 2003) at paragraph 594; *Mitchell v. Pacific Dawn P/L* [2003] QSC 86 (4 April 2003) following Santow J's summary in *Musumeci*

300 (1994) 34 (NSWLR) 723

301 See *South Caribbean Trading Ltd v. Trafigura Beheer BV* [2004] EWHC 2676 (Comm)

302 [1995] 1 WLR 474

no intendment the acceptance of a parcel can be satisfaction to the plaintiff..." When the point arose in *Foakes v. Beer*, Lord Blackburn said in his judgment that Sir Edward Coke was wrong. Lord Blackburn ventured his "conviction that all men of business, whether merchants or tradesmen, do everyday recognise and act on the ground that prompt payment of part of their demand may be more beneficial to them than it would be to insist on their rights and enforce payment of the whole. Even where the debtor is perfectly solvent and sure to pay at last, this often is so. Where the credit of the debtor is doubtful, it must be more so." In the event, Blackburn did not persist with the point as it was apparently not satisfactory to the other four law Lords sitting in the matter. Thus, in *Foakes* v. *Beer*, Lord Blackburn cast doubt on the rule in *Pinnel's Case* and raised as a possibility that the promissor may obtain a practical benefit in settling a debt for a lower amount, and suggested that the practical benefit which would amount to good consideration. Referring to this point, Gibson LJ said:[303]

> "...it is clear that the House of Lords decided that a practical benefit of that nature [prompt payment is more beneficial] is not good consideration in law" and added later " I see the force of the argument [that benefit should extend beyond services to where A is to pay B] but the difficulty I feel with it is that if the principle in *Williams*' case is to be extended to an obligation to make payment, it would in effect leave the principle in *Foakes v. Beer* without application. ... it is in my judgment impossible, consistent with the doctrine of precedent, for this court to extend the principle of *Williams*' case to any circumstances governed by the principle in *Foakes v. Beer*. If that extension is to be made, it should be made by the House of Lords..."

Further, the Report of the Sixth Law Revision Committee of 1937 suggested that the rule in *Pinnel's Case* be overruled.[304] This suggests that were a matter involving an agreement to pay a lesser sum to arise before their lordships, they may well be inclined to depart from the rule in *Foakes* v. *Beer*, following instead Glidewell J's guidance.

The outcome of *Re Selectmove Ltd*[305] was that the court refused to extend *Williams v. Roffey* to alleged agreement to pay the whole of a debt to instalments in the future. It held that it was

---

303 At 538.

304 See also comment in *Esso Petroleum Company v. David and Christine Addison and Others* [2003] EWHC 1730 (Comm); Truck and *Machinery Sales Ltd v. Marubeni Komatsu Ltd* [1996] IEHC 58; and comments of Lord Nimmo Smith in *Joseph McKeand v. Dorian* [2000] ScotCS 108 "Reliance on [Foakes v. Beer] was a very academic way of looking at English Law, and in the last century it has been much diminished in importance by the development of other rules, particularly waiver and promissory estoppel" (paragraph 26)

305 [1995] 1 WLR 474, 481 – [1995] 2 All ER 531.

bound by the House of Lord's decision in *Foakes v. Beer*[306] which prevented enforcement of such an agreement. A similar decision was reached in *Amos v. Citibank* in Australia.[307]

The unsatisfactory result of *re Selectmove* was noted by Peel (1994).[308] He commented that whether a promise to perform an existing obligation may be enforceable is to be determined upon the arbitrary basis of the *nature* of the obligation in question: provision of a service or an obligation to pay money against a debt.

Whilst an exhaustive analysis of the juridical basis of *Williams v. Roffey* is beyond the scope of this thesis, some general comments can be made..

Halson (1990)[309] welcomed the decision noting the adoption of a factual rather than legal definition of consideration, which he thought would be more easily satisfied. He was of the view that duress would ultimately determine the enforceability of the contract modification. He added that the principles of economic duress offered a more sophisticated means of distinguishing extorted and non-extorted modifications. Halson, and others,[310] have expressed the view that the impact of these changes to the law is so substantial as to potentially require reconsideration of the doctrine of frustration. Phang (1991)[311] on the other hand would have preferred reappraisal of consideration by courts and legislature and suggested that courts might in the meantime "supplement the defects of consideration by a bolder development of the doctrine of promissory estoppel." Robertson (2000)[312] made similar comments. It is of interest to note, since Phang's note in 1991, that promissory estoppel has become more prominent in Australia following the decision there of *Waltons Stores (interstate) v. Maher,*[313]

---

306 *Foakes v. Beer* (1884) 9 App.Cas 605. This held that in law the consideration for discharging an indebtedness in a particular sum cannot consist of a promise to pay, or the payment of, a lesser amount of money. Strangely the decision in *Stilk v. Myrick* was not analysed or referred to in this decision

307 *Amos v. Citibank Ltd* [1996] QCA 129 (10 May 1996). Followed *Foakes v. Beer*, saying that some valuable consideration in law must be shown for the creditor's promise to release the unpaid balance of the debt.

308 E Peel (1994) "Part payment of a Debt is not consideration." 110 LQR 353

309 R Halson (1990) "Sailors, Subcontractors and Consideration" 106 LQR 183

310 A Adams and R Brownsword (1990) "Contract, Consideration and the Critical path" 53 MLR 536

311 A Phang (1991) "Consideration at the Crossroads" 107 LQR 21

312 Protecting Reliance: The Emergent Doctrine of Equitable Estoppel by Michael Spence; Melbourne University Law Review 218 (This is a commentary by Andrew Robertson on a book by Spense); and Reliance, Conscience and the New Equitable Estoppel - [2000] MULR 7; (2000) 24

313 (1988) 164 CLR 387

but has not tended to develop in this field in England. Rembert Meyer-Rochow (1997)[314] called for statutory reform of consideration.

One aspect of *Williams v. Roffey* that has been criticised[315] is the flexibility of the "practical benefit" concept. M Chen Wishart (1994)[316] noted that the benefit might be no more than sentimental value of a satisfactory performance. He argues that the practical benefit will often be illusory, and that the seductively simple notion of practical benefit is at the expense of certainty. It remains for the courts to rationalise what limit is put on 'practical benefit' so as to avoid parties abusing change of bargaining power during the contract, whether via the use of duress or otherwise.

The conclusion that might be drawn with respect to enforceability of modifications is that courts are reluctant to set aside commercial agreements made. The practical impact of *Williams v. Roffey* is that parties need only make modest changes to conditions or terms of performance for courts to readily make a finding of practical benefit.[317] Examples would be introduction of a new date for sectional completion or rearrangement of payment arrangements. The new constraining influence will be whether the modification has been introduced pursuant to duress. The prospect therefore of parties successfully resiling from promises to make additional payments in return for changed performance is low under English law.[318]

C. *Economic duress*

A plea of duress by an employer might potentially arise as a means of avoiding an agreement

[314] 71 ALR 532 "The requirement of consideration"

[315] See in part Carter JW, Phang A, Poole J (1995) "Reactions to Williams v. Roffey" 8 JCL 248

[316] "Consideration: Practical Benefit and the Emporer's New clothes" published as Chapter 5 in Good Faith and Fault in Contract Law, by Beatson.

[317] Although note *Evans Deakin Pty Ltd v. Sebel Furniture Ltd* [2003] FCA 171 (12 March 2003) at paragraph 594 where Allsop J refused to find any practical benefit as there was no obvious benefit in the offer made and no surrounding dispute from which to infer some practical consideration.

[318] See also Force Majeure and Frustration of Contract, 2nd edition, by E McKendrick (1995) at 53, 54, 171 and 172.

to pay for acceleration measures. Pleas of this nature are not common: none were evident within the case studies. This section explores the availability in law of such a defence.

Glidewell LJ raised duress as a potential form of defence in *Williams* v. *Roffey* as part of the test whether the promise made (to pay additional sums for accelerative actions) was capable of being good consideration. Purchas LJ said:

> "the modern cases tend to depend more upon the defence of duress in a commercial context, rather than lack of consideration for the second agreement. ... the court is more ready in the presence of this defence being available in the commercial context to look for mutual advantages which would amount to sufficient consideration to support the second agreement under which the extra money is made".

If *Williams* v. *Roffey* is correct, it would appear that economic duress is now the principal control device which places limits upon the conduct of the parties during the renegotiation of a contract. This is of considerable importance to this study. Thus, agreements between parties made during performance of contract obligations which involve changes to the proposed rate of progress, and payment of sums in return for performance to new targets, accelerated completion dates, or for reducing delays (as seen in *Williams v Roffey*) might be set aside if entered into under duress.

Duress, like fraud and misrepresentation, is primarily concerned with the process by which the contract was made (procedural impropriety) rather than whether the terms of the contract are in fact harsh or unconscionable. A contract that has been induced by unlawful or illegitimate forms of pressure or intimidation is voidable on the ground of duress. A restitutionary claim lies for the recovery of money paid under duress, and in many cases the duress will be tortious and give rise to an action for damages for intimidation.

The development of the economic duress doctrine is comparatively recent in English law. Until 1976, the received view was that the only form of duress that could vitiate a contract was actual or threatened violence to the person. Since 1976, the courts have come to accept that, in certain circumstances, a contract can be set aside for economic duress[319] being duress that damages the economic interests of a party.

[319] See particularly *Occidental Worldwide Investment Cpn.* v. *Skibs A/S Avanti*

The original rationale was that duress 'vitiated the consent' of the victim. The fallacy of this approach was exposed in *Universe Tankships Inc. of Monrovia* v. *International Transport Workers Federation*. A person subjected to duress is fully aware of the nature and terms of the contract that is thus entered. The victim still intends to contract, though the contract is made unwillingly. As Lord Scarman said in *Universe Tankships*, "The classic case of duress is ...not the lack of will to submit but the victim's intentional submission arising from the realisation that there is no other practical choice open to him". Thus, the rationale of duress is not lack of knowledge or consent but illegitimate pressure which means that the victim's apparent consent is treated in law as revocable, unless approbated expressly or by implication after the pressure has ceased to operate on the victim's mind.

The relevant principles relating to economic duress were set out by Dyson J in *DSND Subsea v. Petroleum Geo-Services*:

> "The ingredients of actionable duress are that there must be pressure (a) whose practical effect is that there is compulsion on, or a lack of practical choice for, the victim, (b) which is illegitimate, and (c) which is a significant cause inducing the claimant to enter into the contact [[320]]... In determining whether there has been illegitimate pressure the course takes into account a range of factors. These include whether there has been actual or threatened breach of contract; whether the person allegedly exerting the pressure has acted in good or bad faith; whether the victim had any realistic practical alternative but to submit to the pressure; whether the victim protested at the time; and whether he affirmed and sought to rely on the contract. These are the relevant factors."

Despite the limited number of instances matters involving economic duress have come before the courts, some principles are emerging as the nature of threats amounting to duress.

1. A threat to carry out something perfectly within one's rights may be improper if the threat is coupled with a demand that goes substantially beyond what is normal or legitimate in commercial arrangements. *Universe Tankships,* It appears that the courts will be reluctant to apply this so-called 'lawful act' duress to commercial situations[321].

---

[320] Citing as authority *Universal Tankships of Monrovia v. ITWF* [1983] AC 336 and *Dimskal Shipping Company SA v. International Transport Workers Federation (The 'Evia Luck')* [1992] 2 AC 152.

[321] *CTN Cash & Carry Ltd v. Gallaher* [1994] 4 All ER 714. In this case lawful act duress was not established. Steyn LJ explained 'illegitimate' pressure. The critical enquiry, he said, is whether the conduct "is morally and socially unacceptable". This statement was made notwithstanding Birk's (1988) disapproved of this term, as it

2. A threat to commit an unlawful act will constitute an improper threat. A threat to commit a crime or a tort as a means of inducing the coerced party to enter into some contract must prima facie be improper.[322] A threat to break a contract, in certain circumstances may amount to duress. It will not amount to duress where the party is not in fact coerced by the threat or where the victim has had time to reflect on the remedies available. It would also not amount to duress where the threat to break arises from an unexpected difficulty coupled with a demand for money which is not excessive and to which the threatening party believes he is entitled.

3. It is not clear whether a threat not to enter into a contract unless the threatening party's terms are met could ever amount to improper pressure.

4. Apart from the unlawfulness or impropriety of the threat, the threat must be one which leaves the victim no reasonable alternative: this was stressed by Lord Scarman in *Pao On*[323] and *the Universe Sentinel* and by Nolan (1999)[324]

Renegotiations would thus be liable to be set aside where the party whose performance has become more onerous had employed an illegitimate threat that was a significant cause of the other party agreeing to the new terms. Since development of the doctrine, the courts have made a number of decisions involving consideration of economic duress.

In *The Universe Sentinel*[325] the Court of Appeal made a finding of economic duress by the Union, but went on to find that the Union's conduct was protected by legislation. The 'trade dispute' defence was disallowed by HL, and finding of economic duress was not challenged. Lord Scarman noted that duress could exist even if the threat is one of lawful action, as it depends on the nature of the demand.[326]

---

makes the judges arbiters of social evaluation).

322 See Chitty, 7-011

323 *Pao On v. Lau Yiu Long* [1980] AC 614

324 Nolan D (1999) "Economic Duress and the Availability of a Reasonable alternative" [1999] RLR 105

325 *Universe Tankships Inc of Monrovia v. International Transport Workers Federation* [1983] 1 AC 366

326 The courts since then have been reluctant to apply 'lawful act' duress to commercial situations, see *CTN*)

In *B&S Contracts & Design Ltd v. Victor Green Publications Ltd*[327] the claimant sought to recover additional payments it had been promised to complete erection of an exhibition stand. Here, there was very little time available to construct the stand, and the claimant threatened to stop work. Inducements were offered by the employer to facilitate a return to work to ensure the stand was erected in time for the exhibition. The defendant later refused to pay the additional sum promised, and sought to avoid making payment on the grounds that the agreement to pay was only made under economic duress. Lord Scarman's approach in *The Universe Sentinel* was cited with approval. Here the Court made a finding of economic duress, vitiating an agreement to pay additional sums to secure timely completion of an exhibition stand. The lack of any practical alterative but to enter into the supplemental agreement was decisive here.[328]

In *Dimskal Shipping Co SA v. International Transport Workers' Federation*[329] Per Lord Goff, which was a useful reminder that the pressure applied must in law be improper. In *DSND Subsea v. Petroleum Geo-Services*[330] there was no finding of duress, as it was not raised at the time, and contract as affirmed.[331]

Thus, the caselaw has developed in a way that provides considerable scope for courts to review and make decisions based upon a factual review. The law has developed similarly in Australia,[332] New Zealand[333] and Canada,[334] with some modest variations in each state.

327 [1984] ICR 419

328 See also other cases where the agreement was found to be voidable for economic duress: Vantage Navigation *Corp v. Suhail and Saud Hahwan Building Materials (The Alev)* [1989] 1 Lloyd's Rep 138; *Altas Express Ltd v. Kafco (Importers and Distributers) Ltd* [1989] QB 833; *Carillion v. Felix* [2001] BLR 1; CILL 1693

329 [1992] 2 AC 152

330 [2000] BLR 530

331 See also *Williams v. Roffey Bros and Nichols (Contractors) ltd* [1991] 1 QB 1; *Huyton v. Pter Cremer* [1999] 1 Lloyd's Rep 620 where economic duress was considered but no finding was made.

332 *Commercial Bank of Australia v. Amadio* (1983) 151 CLR 447 (following *Pao On*); *Crescendo Management Pty Ltd v. Westpac Banking Corporation* (1988) 19 NSWLR 41 (which said that *Pao On* does not apply in Australia); *Deemscope v. Cantown Pty Ltd* [1995] 2 VR 44; *Westpac Banking Corporation v. Cockerill* (1998) 152 ALR 267; *Bridgewater v. Leahy* (1998) 194 CLR 457; *Mitchell* v. *Pacific Dawn Pty Ltd* [2003] QSC 86

333 *Equiticorp Finance Ltd (in liq) v. Bank of New Zealand* (1993) 32 NSWLR 50

334 *R E Lister Ltd v. Dunlop Canada Ltd* (1979) 105 DLR (3d) 684 (Ont CA) which applied *Pao On; Stott v. Merit Investment Corp* (1988) which approved Lord Scarman's dicta in *Universe Tankships; Muscle Therapy Clinic and Rehabilitation Ltd. v. Procura Real Estate Services Ltd* (1998) ABQB 898; *and Ellis v. Friedland* (2000) ABQB 657

There are, however, several tentative suggestions that relate directly to agreements make to pay additional sums for acceleration. First, the law is developing in a way that reduces opportunities for opportunism.[335] The core principles emerging focus on illegimacy, which Tan (2002) says is just a convenient label for the sort of pressure the law deems should not be used to secure a renegotiated contract. Steyn LJ's reference in *CTN Cash and Carry v. Gallaher* to the critical enquiry being whether the conduct is "morally and socially unacceptable" is relevant here. As Tan notes, the open-ended and fact-dependant nature of the economic duress inquiry means that a myriad of factors has to be taken into account. The better test, to which the law may be turning, simply revolves around the lack of practical alternatives in context.

The deployment of a defence of economic duress is potentially of relevance to acceleration for a number of reasons. First, where work is in delay and the employer is looking to take remedial action, he will typically be looking to act in a short period, and will probably have no time available to find an alternative contractor. The qualifying threat from the contractor would perhaps take the form of going more slowly with the work than planned without explanation, a threat to refuse mitigatory action or a refusal to carry out work leading to the employer promising to pay a sum to resolve the issue.

In summary, applying this practically to acceleration situations, if a contractor refuses to proceed with the work until paid more, a finding of economic duress is not likely to be made by the Courts where the employer has time to find alternative contractors. Where the facility under construction is critically required by a key date and the contractor is merely holding the employer to ransom to secure a greater price, a finding of economic duress is more likely. Significantly, English courts have already made findings of this nature.[336]

D. Absence of formalities, notice or a valid instruction

A commonly made defence to claims in respect of alleged varied work or variations to

[335] R Halson (1991) "Opportunism, Economic Duress and Contractual Modifications" 107 LQR 649

[336] See *B&S Contracts* and *Carrillion v. Felix* [2001] BLR 1; CILL 1693

agreements, albeit not apparent from any of the case studies, is that no sum is due to the contractor because of non-compliance with a formal requirement, such as for notice to be given of delay, or for the instruction to have been confirmed in writing. This point has most frequently arisen before the courts in respect of instruction issued to vary work or the way in which work is to be carried out.

Some of the earlier cases show that defences of this nature were successful.[337] It is evident from later cases in England, and other devices used elsewhere, that courts will strive to avoid allowing an employer to benefit from work requested without liability to pay. In US the federal courts have adopted the fiction of the 'constructive change order', permitting recovery where the court finds that an Officer has not, but should have, issued a variation order. In Canada it is noted that courts have relied upon waiver and estoppel arguments, emphasising the significance of the employer's own knowledge. The approach noted especially in Australia is based upon the breach of a specific duty found by the court that the employer should act fairly and impartially in evaluating any claims made by a contractor, with liability for breach of the duty. Yet another approach is the suggestion that if there is no condition precedent, then further changes were the subject of a separate agreement.

In UK, the frequency with which this point has arisen before UK courts is comparatively rare, largely due to the tradition of contracting on a bills of quantities, permitting oral instructions and valuing variations after their instruction. Difficulties only arise where the change to be made falls outside the limited range of matters that can constitute a variation. The Privy Council in *Molloy v. Liebe*[338] notably permitted recovery. In that case, no payment was to be made for variations unless authorised in writing. Variations were requested, and carried out. It was held[339] that a contract's stipulation that "no extra shall be paid for unless ordered by an order in writing by the architect indorsed by the employer" did not exclude altogether the implied doctrine of law that, when one man does work for another at his requires, an implied obligation arises to pay the fair value of it.

---

[337] *Nixon v. Taff Railway* (1848) 7 Hare 136; *Russell v. Sa da Bandeira* (1862) 13 CB (NS) 272; *Bysouth v. Shire of blackburn* [1928] VLR 562.

[338] (1906) 4 CLR 347

[339] Per Griffith CJ at 353 in Australia, . The decision was revered by the Privy Council on other grounds (see (1910) 102 LT 616)

The principle upon which *Liebe* was decided is no longer considered sound. Instead, following *Pavey v. Matthews*,[340] the basis of liability rests in some circumstances in the law of restitution. Although a decision of the High Court of Australia, this principle has been adopted by the English courts.[341]

Clarifying the relationship between contractual provisions and the doctrine, Mason P confirmed in *Trimis & another v. Mina*[342] that "no action can be brought for restitution while an inconsistent contractual promise subsists between the parties… As Deane J explained in the context of the quantum meruit claim in *Pavey & Matthews*, if there is a valid and enforceable agreement governing the claimant's right to payment, there is 'neither occasion nor legal justification for the law to superimpose or impute an obligation or promise to pay a reasonable remuneration'".

Restitutionary remedies have developed in a number of defined situations. Two types of situations of note here. The first is where work is done but contractual formalities are not complied with. Here, recovery by a contractor of costs incurred is evident: see two Australian cases, *Update Construction v. Rozelle*[343] and *GEC v. Marconi*. The second is where work is done but found to be outside the scope of the original contract where again contractors have recovered: in *Brodie v. Cardiff Corporation*[344] and *Peter Keweit Ltd v. Eakins Cosntruction Ltd.*[345] The important summary to be drawn here is that defences based upon lack of authority or scope arguments are unlikely to succeed where the work or changed work was carried out in the full knowledge at the time.

The development of the law of restitution[346] is thought most likely to provide a remedy to a contractor that is asked to do something beyond the architect's authority or outside the contract's permitted scope, providing recovery on the basis of a contractual or restitutionary

---

340 (1987) 162 CLR 221

341 *Lipkin Gorman v. Carpnale Properties*; *Clarke & Sons v. Act Construction* [2002] EWCA Civ 972; *Vedatech Corporation v. Crystal Decisions* [2002] EWHC 818

342 [1999] NSWCA 140 16 BCA 288

343 (1990) 9 ACLR 66

344 [1919] AC 337

345 (1960) 22 DLR 465; [1960] SCR 361

346 About which more is said in the quantum section

quantum meruit. It follows from the above, that where work is ordered, a defence based on lack of compliance with formal requirements does not stand a strong prospect of success.[347]

E. The 'mitigation' defence

There is a notable tendency from Case Studies for employers or professionals to allege that the contractor was under a contractual duty to use best endeavours to mitigate delay. Hence, so the argument goes, 'accelerative' actions were taken pursuant to that duty so there is no basis upon which a claim for additional costs can be made. This section is concerned with understanding the nature and scope of the contractual provisions alluded to here.

This argument typically arises where progress of the works is in delay and the contractor is implored by the employer, architect or engineer to take some positive action to finish on time. The contractor responds by rescheduling the work to be carried out and by deploying at the site the necessary additional resources required to meet the revised schedule. Once work is complete, the contractor typically seeks to recover from the employer the additional costs incurred on the basis that he was acting pursuant to the instructions of the employer to recover delay. The employer says that the contractor was merely to work pursuant to the contract's provisions.[348] In the light of this typical scenario, a number of matters are considered here:[349]

- the structure and relevance of the 'best endeavours' clause; and
- what might be expected of the contractor using his 'best endeavours' to reduce delay.

1. Contractual provisions for 'mitigation'

Standard forms typically contain a number of inter-related time provisions. First, there is a

[347] See also *Hudson*, 7.040 to 7.101 for a detailed review of these provisions..

[348] See for example Case Study on National Exhibition Centre

[349] Whether, or the extent to which a claim for additional costs might be founded on best endeavour provisions is dealt with in a later section.

provision requiring the contractor to proceed regularly and diligently with the works. It is implicit that this provision should apply whether progress the works is on time or in delay. Second, most standard forms contain a power reserved to the architect or engineer to extend the date for completion. The provision is designed to keep alive the employer's right to deduct liquidated damages. The extension of time to be awarded is typically limited by three factors: (a) that the extension is only granted in respect of a limited category of delaying events;[350] (b) that the extension is only granted where the event caused delay to completion; and (c) that the contractor had taken steps to limit or reduce delays being incurred. It is this last provision that is relevant here. It is often expressed in the shorthand that the contractor is to use his 'best endeavours' to limit or reduce delays, or simply the contractor has a duty to mitigate delays.

Provisions in agreements with respect to best endeavours are not new. Clause 23 of the RIBA form, as it existed in 1898 provided:

> "23. If in the opinion of the architect the works be delayed by [various causes are listed] the architect shall make a fair and reasonable extension of time for completion ... But the contractor shall nevertheless use his best endeavours to prevent delay, and shall do all that may reasonable be required to the satisfaction of the architect to proceed with the works." [351]

It is immediately evident that this 'best endeavours' provision acted as a proviso to the award of an extension of time. Some fifty years later, in the 1949 edition, a similar clause was to be found.[352] Clause 25 of what is now the JCT Standard form, 1998 Edition, is more extensive but is similar in structure and language to that of a century earlier. The relevant part of clause 25 reads:

> **25 Extension of time**
>
> 25.3.1.1 If in the opinion of the Architect, upon receipt of any notice, particulars and estimate ... any of the events which are stated by the Contractor to be the cause of delay is a relevant event and the completion of the Work is likely to be delayed thereby beyond the Completion Date the Architect shall in writing to the Contractor give an extension of time by fixing such late date as the Completion Date as he then estimates to be

[350] Referred to as 'relevant events' under the JCT forms and 'Compensation Events' under the ECC forms.

[351] See *Sattin v. Poole*; See also the RIBA form reproduced in Hudson's Building Contracts, 4th Edition, at page 613.

[352] See for example *Amalgamated Building Contractors v. Waltham Holy Cross* [1952] W.N. 400; [1952] 2 All ER 452 where the relevant provision is cited in the judgement.

fair and reasonable…

25.3.4 Provided always that:

25.3.4.1 the Contractor shall use constantly his best endeavours to prevent delay in the progress of the works, howsoever caused, and to prevent the completion of the Works being delayed or further delayed beyond the Completion Date.

25.3.4.2 the Contractor shall do all that may reasonably be required to the satisfaction of the Architect to proceed with the Works.

This provision has not been subject to any detailed judicial scrutiny.[353] Little guidance is available either from authors of the form or commentators.[354] Hence, some further analysis is merited.

A number of observations can usefully be made on the proviso in clause 25.3.4. First, it is not of general application. The best endeavours provision only acts as a proviso to the right to an extension of time and thus applies where the work is delayed by acts or omissions for which an extension of time might be awarded. It does not therefore apply where delays to progress of the work were caused by matters for which the contractor is responsible (in which case the obligation to progress the works regularly and diligently applies in any event), and does not apply where there are no delays to progress at all. Second, and perhaps more importantly, the clause appears, on one view, to expressly impose obligations on the contractor to limit or reduce delay. Third, the proviso is drafted as a condition precedent to award of more time. This suggests that no time award would be due in respect of avoidable delay, or that non-compliance at least influences the duration of the extension of time, if any, the architect may chose to award.

2. Purpose of the proviso

No guidance is available from JCT, authors of the standard form, as to the purpose of this clause. As Keating states[355] the clause is "an important qualification of the right to an extension of time".

---

[353] Comments by Hicks J in *Ascon* are considered later when dealing with claims to recover additional costs incurred.

[354] A short commentary is provided in Keating's Building Contracts, considered later.

[355] 6th edition, page 642

The purpose of the clause becomes evident when considering the consequences were the clause to be omitted. Take, for example, a project where a contractor agreed to build two brick walls over a three-month period. Assume also that the two walls are progressed simultaneously (the contractor's choice) and the contractor, given the nature of the work and resources engaged, is capable of allocating bricklayers to any wall and reallocating labour to the other wall at no cost. In the event that progress to one wall was to stop completely for one week, due to non-receipt of construction drawings or because of a difficulty with ground conditions, it can be expected that the contractor might request, and expect, an extension of time of one week. Such an analysis ignores the proviso.

But it may also be said that it would be unreasonable, and undesirable from the employer's perspective, if the contractor withdrew from the site the bricklayers working on the affected wall, when he might have reallocated them to work on the other wall. By retaining and redeploying labour on site the rate of progress to the other wall would increase, and as soon as the difficulty is resolved, labour could be reallocated to the extent that both walls might, once again, be progressed simultaneously and might still be completed on or near the contract completion date. The rate of progress may temporarily fall short when working on one wall only, particularly where there are space or resource limitations. On one view at least, it is undesirable that the contractor be awarded an extension of time of one week when, by reallocating labour from one wall to the other without incurring any additional cost, the delay might have been avoided altogether. Viewed another way, a contractor in this situation, using the example of the two walls being built, might say that carrying out the work and reallocating labour as a consequence of the problem means that work will not proceed exactly as planned. It would be equally undesirable from the employer's perspective if the contractor were to say that he was not prepared to depart from the exact sequence of work envisaged by his initial programme even where it might be possible to reallocate labour without incurring any cost at all. Hence, the proviso encourages redeployment of resources at the time; it encourages efficient use of resources and discourages waste of resources or time.[356]

The principle might be further illustrated by another example, where a contractor is to build a house by 1 October but where the employer undertakes to provide all timber to the contractor

[356] It should be noted that performance to the proviso may involve work being carried out uneconomically. The economic consequences, and potential for recovery of costs, are considered separately in the next chapter.

for incorporation into the works. The timber is to be delivered in monthly consignments. One consignment of timber is destroyed en route to the site so the employer is in breach of an obligation to secure timely delivery of timber to site. Replacement via the employer is expected to take one month. Were the contractor to await the new delivery completion of the whole works would be delayed also by one month. This in turn would result in additional time-related costs being incurred. Were the contractor to purchase the timber of similar grade locally, with the employer's consent, he might recommence work within a few days.[357] It would appear, by application of the rule, that the contractor's time recoverable would be limited were the latter option available.

It would appear that the proviso is directed at avoiding these situations arising. Thus, the proviso puts on the contractor a positive obligation to adjust the intended plan of work, or to adjust planned resource allocations, so as to minimise delays. A consequence of this should also be to reduce time-related costs incurred as a consequence of the delay, thereby reducing amounts payable by the employer in respect of qualifying causes.

3. The Proviso and Mitigation

Many practitioners refer to the proviso as a 'duty to mitigate delay'. This raises questions: whether there is any relationship between the contractual proviso and common law 'duty'; and whether anything learnt from studying the common law mitigation doctrine might be of use in understanding the ambit or scope of the contractual provisions.

The mitigation doctrine comprises three uncontroversial rules.[358] The first rule, put simply, provides that the plaintiff will not be allowed to recover for losses that could have been avoided by taking reasonable steps. As Viscount Haldane LC said:

> "The fundamental basis is thus compensation for pecuniary loss naturally flowing form the breach; but this first principle is qualified by a second, which imposes on a plaintiff the duty of taking all reasonable steps to mitigate the loss consequent on the breach and debars him from claiming in respect of any part

[357] If he could not purchase locally, presumably he would demobilise labour to save cost exposure.

[358] Chitty, 27th Edition, 27-085

of the damage which is due to his neglect to take such steps." [359]

There was, following this decision, much debate as to the true nature of the 'duty to mitigate'. In *The Solholt*, Donaldson M.R. presented some welcome clarification of the plaintiff's position when exposed to loss when he said:

> "A plaintiff is under no duty to mitigate his loss, despite the habitual use by lawyers of the phrase 'duty to mitigate'. He is completely free to act as he judges to be in his best interests. On the other hand, a defendant is not liable for all loss suffered by the plaintiff in consequence of his so acting. A defendant is only liable for such part of the plaintiff's loss as is properly caused by the defendant's breach of duty." [360]

The rationale of the mitigation rule is to encourage parties to avoid unnecessary waste. It is a policy-based doctrine to limit recoverable damages. It is a rule, sourced in economics, which goes to limit damages that might otherwise be recovered were recovery to be based alone on causation. Some recent decisions suggest that the rule is one of causation, in that the chain of causation is broken by the defendant's failure to act reasonably in limited losses when an opportunity was available to do so. It is, however, a rule of damages. The rule is not that a party should take action to limit another party's ongoing *breach*, but that he should take steps to limit *damages* consequent upon that breach. In the context of construction work under progress, this important distinction is often overlooked.

In practical terms the innocent party is expected to act positively to reduce his own loss, but need only do what is reasonable. Viscount Haldane suggested in *British Westinghouse* that the principle "does not impose on the plaintiff an obligation to take any step which a reasonable and prudent man would not ordinarily take in the course of business".[361] The trend in mitigation decisions in UK is not to expect the plaintiff to incur large expenditure or great risk. Thus, it is settled law that he need not take risks that would involve him in complicated litigation[362] or which would ruin his commercial reputation.[363] What is reasonable is a

---

[359] *British Westinghouse Electric and Manufacturing Co.* v. *Underground Electric Rly Co of London* [1912] AC 673 at 689, per Lord Haldane.

[360] [1983] 1 Lloyd's Rep. 605 at 608

[361] [1912] AC 673 at 689, approving *Dunkirk Colliery Co. v. Lever* (1878) 9 Ch.D. 20 at 25.

[362] *Pilkington* v. *Wood* [1953] Ch. 770

[363] *James Finlay & Co. Ltd* v, *N.V. Kwik Hoo Ting H.M.* [1929] 1 K.B. 400

question of fact in the circumstances of each case.[364]

The second rule, confirmed by Lord Haldane in *British Westinghouse*, is that if the plaintiff in fact avoids or mitigates his loss consequent upon the defendant's breach, he cannot recover for such avoided loss. This is so even though the steps he took were more than could be reasonably expected of him.

The third rule is that where the plaintiff incurs loss or expense in the course of taking reasonable steps to mitigate the loss resulting from the defendant's breach, the plaintiff may recover this further loss or expense from the defendant. This is so even when the mitigating steps were unsuccessful or in fact led to greater loss.[365] Jurisprudentially, this rule is justified on the basis that it is in the interest of the defendant (as well as of the wider society) that the plaintiff, who is usually in the better position to minimise his loss, should be encouraged to try to do so. He may recover the cost of his reasonable attempt to extricate himself from the position in which he was placed by the breach.[366] Whatever action the contractor takes, he will only recover additional costs incurred where the action taken was reasonable. Whether the plaintiff has failed to take a reasonable opportunity to mitigate is a question of fact dependant upon the particular circumstances of each case. The burden of proving such failure rests upon the defendant.[367]

The so-called duty to mitigate therefore has two aspects: in the first place, the plaintiff must take reasonable steps to minimise his loss; the injured party need only take such steps as are reasonable. Secondly, the plaintiff must forbear from taking unreasonable steps that increase his loss. If the plaintiff acts unreasonably in attempting to mitigate, he cannot recover extra loss that he suffers as a result. This indicates that a contractor should do no more than might be considered reasonable.

The mitigation rule is a rule of damages, aimed at limiting recoverable damages consequent upon a breach by excluding damages that might reasonably have been avoided. Arguably it has no direct application to an express term of a construction contract in respect of delay. This

[364] Per Bankes LJ in *Payzu Ltd* v. *Saunders* [1919] 2 KB 581

[365] *Wilson* v. *United Counties Bank* [1902] AC 102, 125

[366] *County personnel (Employment Agency) Ltd* v. *Alan R Pulver & Co.* [1987] 1 WLR 916, 926

is correct in that there is no direct reference to mitigation within the proviso. It is submitted, however, that an understanding of the mitigation doctrine can act as an aid to understanding the application of the underlying rationale of the proviso. It can also help when addressing the issue as to whether costs incurred in complying with the proviso are potentially recoverable, a matter on which the JCT form is crucially silent.

There is, it is suggested, a similar underlying rationale between the mitigation doctrine and the proviso. The former acts to limit recovery of damages as a consequence of a breach. The latter acts to limit recovery of additional time as a consequence of a contract term. The former is policy driven, designed to encourage economic use of resources and avoid abuse. The latter is similarily designed to encourage economic use of resources and avoid abuse.

The similarity between the mitigation rule and the proviso to clause 25 is immediately evident by taking Chitty's short summary of mitigation rules, and changing the words 'loss' and 'damages' to 'delay' and 'extension of time' (and leaving 'loss and expense' unchanged):

> The mitigation doctrine comprises three uncontroversial rules. First, the claimant cannot recover ~~damages~~ [an Extension of time] for any part of his ~~loss~~ [delay] consequent upon the defendant's breach of contract which the claimant could have avoided by taking reasonable steps. Secondly, if the claimant in fact avoids or mitigates his ~~loss~~ [delay] consequent upon the defendant's breach, he cannot recover for such avoided ~~loss~~ [delay], even though the steps he took were more than could be reasonably required of him under the first rule. Thirdly, where the claimant incurs loss or expense in the course of taking reasonable steps to mitigate the ~~loss~~ [delay] resulting from the defendant's breach, the claimant may recover this further loss or expense from the defendant.[368]

From this, it is suggested that the proviso functionally acts to replicate within the standard form of contract the mitigation rules in relation to delays incurred. It does so by placing on the contractor an obligation to help avoid unnecessary or avoidable delay. The implications of this on cost issues are explored later.

---

[367] *Payzu* v. *Saunders* [1919] 2 KB 581, affirmed by Donaldson MR in *The Solholt*.

[368] Chitty, 27th Edition, 27-085

4. The application of the mitigation rule

The question as to what actions may be reasonable for the claimant to take in mitigating are important, not least because, as noted above, the claimant will be unable to recover costs arising from acts found to be unreasonable. Analysis of the mitigation rules in application suggests that there are two inter-related limitations on what might be found to be reasonable: the time within which mitigatory actions are taken and costs incurred.

Time as a limiting factor can be illustrated by some examples.

> In a transaction for sale of goods a buyer is advised that goods due to arrive at the quayside within one week were lost at sea and replacements will not be forwarded for two months.[369] Here the buyer has two options: he can await delivery of the goods at a later date; or he can immediately secure similar goods from an alternative source. If he awaits delivery, he may lose his sale to a third party or he may suffer losses due to changes in market conditions. The practical effect of the mitigation rule is that he cannot recover damages for the time lost awaiting the arrival of replacement goods, or for the loss of a sale, when he might have avoided much of his loss by purchasing alternatives if that option was reasonably available. Thus, operation of the rule requires the innocent party to take positive action to reduce the losses consequent upon the breach.

The position is somewhat more complicated where the scarce resource (like timber in the last example), cannot be readily sourced from elsewhere at short notice or where responsibility for supply clearly lies with the employer alone.

> Take the situation of a contractor proceeding with work who is suddenly unable to proceed due to the absence of key design information, information that is to be supplied by the employer or the design team for which the employer is responsible. The work stops for one week. In practice, there is little the contractor can do. He cannot supply the design information that is causing the delay. He can only await its receipt from the employer, architect or engineer. It may be that the contractor is not

[369] Assume here that this is a breach sounding in damages.

sure when this might be remedied. The best he can do is (a) advise the design team in advance of the times he expects to the require information; (b) advise at the time that the information is not available and (c) minimise losses during the week of inactivity, perhaps by redeploying resources elsewhere. Once the information is provided, work can proceed again. The contractor's difficulty, and losses, is confined to the week in question. If the works as a whole finishes one week late as a consequence of this problem, the contractor will expect an extension of time to be granted, and to be relieved of delay damages. He may also be able to recover additional costs incurred in the week of difficulty as damages for delay. The argument then is whether the contractor might have taken some action to mitigate those delay damages he has incurred.

Although not immediately apparent from the example above, there are two distinct periods during which the contractor might take positive action to reduce losses. The first (temporary) phase arises during or in the immediate aftermath of the delaying event arising, whether it is non-delivery of materials or information, a request to undertake additional work, bad weather or whatever. In this period resources might be reallocated quickly to other work on the site appropriate to the resources in question. Thus, bricklayers can be reallocated to brickwork in other areas, if there are sufficient bricks, design information and available areas in which to work, etc. The second period in which positive action might be taken is when progress has regained equilibrium following the delay, when it is clear that the outstanding work is unlikely to be completed within the available contract period remaining.

Whilst these examples have been cited in relation to losses arising from a breach of a contractual obligation, therefore bringing into play the mitigation rule, it is thought that this principle of the time during which action might be taken to mitigate is of equal relevance to delays incurred and actions that might be taken to avoid or reduce delays. This might be referred to as the acceleration phase. Then the action required to secure timely delivery may be more complicated involved significant reprogramming or extensive weekend working.[370] It is

[370] Using the analogy of a car journey, there is first the period when the car has to slow and stop when road works is encountered. Fuel is conserved by not revving the engine excessively. Once the car journey recommences, the driver has the opportunity of taking action to get to the destination by the original time, although by this stage in delay due to road works encountered, by altering the route or driving faster than planned.

suggested that the actions anticipated by the mitigatory rule relate principally to those taken at the time of, or immediately after, delays are incurred.

So far as a cost limitation is concerned, as the third rule limits recovery to costs incurred in reasonable actions, so the actions that can be expected to be taken can be expected to be limited to those for which costs might be recovered. It is suggested this point also is of direct relevance to delays. The suggestion is made, in the later quantum section, that a contractor ought to be able to recover costs incurred in mitigating delay, as loss and expense recoverable replicates damages. If this is right, then the efforts taken to mitigate should not be unreasonable. Again, this points to limited reallocation of resources at the time of the delays or soon thereafter but would not anticipate much thereafter. Alternatively, it suggests action that is not going to result in significant cost exposure. Thus, an understanding of the mitigation rule aids interpretation as to the likely scope of actions anticipated of contractors and of the equivalent contractual provision in agreements in respect of delay, and also of the timing of any such action.

So what action, to use Lord Haldane's dictum, would a reasonable and prudent contractor take? The response, it is suggested, weighs in favour of action at or around the time of the delay. If applied to delays in the construction context, the view emerging here is that reprogramming, seen in the context explained here, is limited to reprogramming at the time the delay occurs, not after the entire delay has passed. Keating says, of the proviso, that "it might be the contractor's duty to reprogramme the Works either to prevent or reduce delay. How far the contractor must take other steps depends upon the circumstances of each case, but it is thought that the proviso does not contemplate the expenditure of substantial sums of money." The analysis above, in the main, supports Keating's view. It is suggested that the need to carry out mitigatory work close to the time of the delay operates as a useful additional clarification to Keating's commentary.

A point of issue may arise however with Keating's suggested limitation based upon sums expended. This may be taken to mean that sums expended should be limited to what was contemplated by the parties at the time of formation of the contract as to the type and quantum of expenditure that might have been foreseen at the time, echoing the first limb of *Hadley v*

Baxendale.[371] If so, it might be added that expenditure (and hence recovery) of greater sums is in order if the other party is put on notice at the time of the propose actions and some consent was sought and received. In this contect, sums expenditure may be very substantial indeed.

5. The meaning of 'best endeavours'

The proviso requiring the contractor to reduce delay, as noted above, is not drafted in absolute terms. The requirement is for the contractors to use 'best endeavours' to reduce or prevent delay. The ambit of the 'best endeavours' obligation has never, it seems, been considered in any detail judicially with respect to construction contracts. Berg (1992, pages 99 to 103) and Noble (1997, page 295) conclude, after a consideration of authorities where the expression 'best endeavours' is considered, is that this is not a *de minimis* obligation: compliance requires more than the minimum action is required. Neither author addresses application of these provisions to construction contracts. Some further analysis is required to understand the rationale of these provisions.

Best endeavours provisions have been considered in a number of decisions of the English courts. In *Terrel v. Mabie Todd and Company*[372] Sellers J. held that an obligation to use "best endeavours" to promote the sales of a product, meant a duty to do what could reasonably be done in the circumstances; the standard of reasonableness being that of a "reasonable board of directors acting properly *in the interests of their company* and applying their minds to their contractual obligations to exploit the inventions" [Emphasis added].

In 1980, the Court of Appeal considered an obligation to use "best endeavours" in *IBM (UK) Ltd v. Rockware Glass Ltd.*[373] In that case, Rockware agreed to sell land to IBM for £6m and the agreement provided that "the purchaser will make an application for planning permission and use its best endeavours to obtain the same". Planning permission was sought and refused. Rockware argued that the planning authority's decision should have been appealed. Allowing the defendant's appeal Buckley, Lane and Goff LJJ declared that IBM: "are bound to take all those steps in their power which are capable of producing the desired result, namely the

[371] (1854) 9 Ex. 341

[372] (1952) 2 TLR 574; [1952] 69 RPC 234

[373] (1980) FSR 335

obtaining of planning permission, being steps which a prudent, determined and reasonable owner *acting in his own interests* [emphasis added] and desiring to achieve that result would take". Buckley LJ said that the obligation was not to be measured by reference to someone who is acting under a contractual obligation but someone who is acting in his own interest. Lane LJ stated "these words [best endeavours] oblige the purchaser to take all those reasonable steps which a prudent and determined man, *acting in his own interests* [italics added] and anxious to obtain planning permission, would have taken."

The common thread running through the *Terrel* and each of the judgments in *IBM* above was the requirement of "acting in one's own best interests", acting as if one's own interests are at stake rather than others. On this basis, it would appear that the standard of reasonableness applicable in respect of a construction contract would be that of a reasonable board of directors acting properly in the interests of their construction company and desiring to prevent delay in the progress of the works. Yet this test, when applied to construction delays, may be difficult to apply. There are potentially several views available:

- The first is that the contractor, acting in his own best interests where work has been delayed by the employer or some other reimbursable event, and for which he might recover reimbursement of time-related costs and losses, will merely notify the employer of the delay. The first view can be quickly discounted. Mere notification of a delay, for example, runs against the very objective of the proviso, which is to use best endeavours *to reduce delays*. Thus, it seems some further action is required;

- The second view is that the contractor take minimal efforts to reduce delay, by redeploying labour for example, but does not incur significant cost generally *without having put the other party on notice* (emphasis added). This is the view taken by Keating, quoted above;

- The third view is that the requirement to 'act in his own interest' should be interpreted 'act is if you, the contractor, had to deal with this problem yourself'.

The choice between second and third views is one of degree. The third view, on the face of it, is consistent with the facts and dicta of *Terrel* and *IBM*. Thus, the contractor would be dealing with the delay as if he had caused it himself. But the difficulty with this view is that it probably requires intervention to recover delays after they have been incurred, rather than just redeploying resources to ensure their efficient use at the time of the delay. It also seems excessive: the rational contractor will seek to take action at the time rather than engaging in a vast exercise later in recovering delays.

The second view, echoing Keating, seems preferable. It involves taking sufficient action to show that resources are being redeployed at the time so as to ensure their efficient use without either jeopardising the award of more time and without futile waste of resources in seeking to recover all delays. In principle, this approach falls short of doing "everything that reasonably can be done in the circumstances". The better view is that those words need to be seen in the context of delays and the mitigatory provisions.

Thus, any analysis based upon what might be 'in his own best interests' must presuppose that the cause of delay was a matter for which the contractor was responsible: the focus then is upon the actions the contractor might have taken if was in culpable delay. The sensible answer here, in all probability, is that the contractor would act in a way that reduced the risk of greater financial exposure: he might be expected to act at the time of the delay, without incurring significant expenditure, if it were to reduce his exposure overall.

The conclusion from this analysis, having considered the position of the contractor in the face of delays caused by a variety of matters, would seem consistent with Keating's comment that the 'best endeavours' provision does not envisage significant expenditure *without having put the other party on notice* (emphasis added).

6. Scope of the proviso generally

Little guidance is available with respect to the scope of the proviso: this is a notoriously contentious area. A conceptual analysis suggests a range of views is available:

- The contractor, acting in his own best interests where work has been delayed by the employer or some other reimbursable event, and for which he might recover reimbursement of time-related costs and losses, is merely obliged to notify the employer of the delay incurred. According to this view, the contractor should hardly be put to resolving delays of the employers making. This view can be quickly discounted. Mere notification of a delay, for example, runs against the very objective of the proviso. It shows no effort to use best endeavours *to reduce or prevent delays*. Thus, it seems some further action is required.

- The second view is that the contractor should only take minimal efforts to reduce delay, by redeploying labour for example, but need not incur significant cost generally. This is the view taken by Keating, commented upon further below.

- The third view is that a wide interpretation of the proviso is required, requiring the contractor to do all in his power to reduce or eliminate delays.

There are, it is suggested, a number of difficulties with the third view. First, taken literally, the actions to be taken might be limitless. If the project was delayed by one month, but only two month's work to be done, the labour force on site may need to be doubled to recover the delay. Two difficulties arise: action of that nature falls outside what would ordinarily be expected; and the contractor's cost incurred in trying to recover delays of that nature would be disproportionately high were they to fall for recovery. The expenditure to recover time may be wholely disproportionate to the value to the project. The better view, it seems, is that the extent of effort put into reducing delays is limited by what might reasonably be expected, having regard to the employer's expected liability for costs incurred in reducing delays. Second, the contractor's interest in recovering time may be limited by the extent to which he perceives the cost of recovering time might be recovered from the employer. Put another way, contractors would not be expected to attempt to recover delays when to do so might expose themselves to substantial losses.

Third, if the analogy of mitigation is pursued, that rule goes to limiting recovery, not to eliminating liability altogether. The difficulty with this view is that it probably requires intervention to recover delays after they have been incurred, rather than just redeploying resources to ensure their efficient use at the time of the delay. It also seems excessive: the rational contractor will seek to take action at the time rather than engaging in a vast exercise later in recovering delays.

Keating says, echoing the second view above:

> "Clause 25.3.4. The proviso is an important qualification of the right to an extension of time. Thus, for example, in some cases it might be the contractor's duty to reprogramme the Works either to prevent or reduce delay. How far the contractor must take other steps depends upon the circumstances of each case, but it is thought that the proviso does not contemplate the expenditure of substantial sums of money."

The second view, echoing Keating, seems preferable. It involves taking sufficient action to show that resources are being redeployed at the time so as to ensure their efficient use without either jeopardising the award of more time and without futile waste of resources in seeking to recover all delays. In principle, this approach falls short of doing "everything that reasonably can be done in the circumstances". The better view is that those words need to be seen in the context of delays and the mitigatory provisions.

7. Other forms

The MF/1 form

The provisions under this form are perhaps the most straightforward and easy to understand. The form contains two separate provisions requiring contractors to mitigate delays incurred. The first, under clause 14.6, is in respect of delays which the engineer believes are incurred but for which no extension of time is due, otherwise commonly known as culpable delays. The second provision deals with excusable delays, under sub-clause 33.3 (titled mitigation of consequences of delay) is included as part of the extension of time provisions. Both provisions were introduced for the first time in the 1988 Edition of the form. The two provisions read:

> 14.6 The Engineer shall notify the Contractor if the Engineer decides that the rate of progress of the Works or of any section is too slow to meet the Time for Completion and that this is not due to a circumstance for which the Contractor is entitled to an extension of time…
> Following receipt of such a notice the Contractor shall take such steps as may be necessary and as the Engineer may approve to remedy or mitigate the likely delay, including revision of the Programme. The Contractor shall not be entitled to any additional payment for taking such steps.
>
> '33.3 In all cases where the Contract has given notice under sub-clause 33.1

> (extension of time for completion) the Contractor shall consult with the Engineer in order to determine the steps (if any) which can be taken to overcome or minimise the actual or anticipated delay. The Contractor shall thereafter comply with all reasonable instructions which the Engineer shall give in order to overcome or minimise such delay. If compliance with such instruction shall cause the Contractor to incur additional cost and the Contractor is entitled to an extension of time the amount thereof shall be added to the Contract Price.

The commentary published with the form notes, with respect to an engineer's use of provisions under clause 14.6 that "the engineer who seeks to operate the provisions of the sub-clause must take the greatest possible care to ensure that he can justify the reasons for serving the notice, otherwise the Purchaser will almost certainly have to reimburse to the Contractor any "acceleration" cost that the Contractor may have incurred in consequence of the engineer's notice.

In the commentary against clause 33.3 it is noted that if the Contractor is not entitled to claim the extension of time but nevertheless the Engineer gave instructions to mitigate the consequences of delay, a possible approach would be for the Engineer to give the instruction under sub-clause 14.6 in order to avoid any argument that the Contractor was entitled to be paid extra cost, save that if the order given under clause 14.6 was ill-founded, the contractor may ignore it.

These provisions, in the main, are sensible. Each provision effectively prevents surprises in that they require the Engineer's consent before accelerative or mitigatory measures are taken. So long as the Engineer notes that the notice is given under both clauses, the message provided to the contractor is unequivocal – if you are awarded the extension you will also be paid the additional costs incurred in mitigation. The merit of these provisions is that they do not put the onus on the contractor, as might occur under the common law, of balancing measures to take to mitigate and costs likely to be incurred against the prospects of success. Clause 33.3 effectively replaces the common law duty to mitigate with a more measured engineer-led provision. The engineer or employer will need to take care to limit measures taken, particularly as instructions given pursuant to this provision may be open ended or based on inputs, rather than focusing on outputs. .

It is also notable that under sub-clause 14.5 the Engineer is given power to order the contractor to revise the programme if the progress of the Works either falls behind or moves ahead of programme. The intention, according to the commentary, is to enable the parties to work to a Programme that reflects actual progress rather than desired progress. There are also detailed provisions in clause 14.1 allowing the engineer to influence both form and content of the programmes. What this does is to put the engineer in a position where he might intelligently evaluate progress and might evaluate the contractor's proposed corrective action.

ICE 7th Edition

This form contains provisions similar to the MF/1 form, with one striking omission. Clause 14(4) requires an updated programme to be provided showing actual progress. Clause 46 (1) makes clear that where progress of the work is too slow for reasons that do not entitle the contractor to an extension of time, the engineer shall notify the contractor of steps required to expedite progress of the works. The clause contains the provision "The contractor shall not be entitled to any additional payment for taking such steps". This clause usefully clarifies the liability for costs incurred. A similar provision might usefully be added to the JCT forms. It is notable that the extension of time provision contains no proviso within the extension of time clause similar to that referred to above in the JCT form. Arguably the Engineer, in his assessment of extension of time due, can exclude delays that might have been avoided by reasonable action by the contractor: see for example power under clause 13(3)[374] to allow "such cost as may be reasonable except to the extent that such delay and extra cost result from the contractor's default. Overall, it appears that there is no provision in the ICE form replicating the common law duty to mitigate.

Summary:

The drafting of JCT provisions appears to leave the whole question of mitigation to the contractor. The express provisions to be found in other forms covering responsibility for payment against requests to arrest delays provide greater clarity for all parties.

The view that the obligation to take best endeavours is consistent with the mitigation rule suggests that costs incurred in mitigating might be recoverable if at a reasonable level.

[374] This clause (titled 'Delay and extra cost') deals with payments as a consequence of delay.

Consistent with this is the view that the best endeavours obligation requires the contractor to take those steps that he would if the causes of delay were his own. It would appear from clause 26 that all costs incurred in mitigating delay are recoverable as loss and expense, being a consequence of the delay incurred. The better view, it would seem is that a contractor risks non-recovery of excessive expenditure on mitigation measures. The expense may be viewed as not being a natural consequence of the delay, and thus remote, or beyond what might reasonably have been contemplated by the employer. The contractor, acting prudently, will put the employer on notice of the sorts of expenditure anticipated by way of mitigation, in advance.

F. Conclusion on defences

This section sought to bring together many of the leading forms of defence that might be found where a contractor has accelerated in full knowledge of the employer. Defences identified as having been adopted, from case studies and analysis of possible defences fell into five categories.

Causation-based defences were noted as being inherently weak, in that they are based on finite information whereas information at the time may have been less finite.

The pre-existing duty defence, whilst superficially attractive, is all but redundant following the decision of the Court of Appeal in *Williams v Roffey* in 1989. A tribunal need only find a positive benefit in the new arrangement in order to maintain it.

Pleas of economic duress, as a mechanism to avoid an agreed can succeed under limited circumstances, but can easily fail where it is shown that the complainant waived the complaint or acquiesced at a later date.

Claims that acceleration is void for want of formality or authority may temporarily succeed in contract but ultimately offer little prosect of success in any jurisdiation that supports the modern development of the law of restitution. Many old decisions based around certification or lack of formality, or conclusivity of certificates may be unreliable.

Mitigation-type defences equally offer little protection in defending acceleration claims. If anything, they may provide grounds for recovery of costs incurred.

The principal conclusion to be drawn is that the prospect of maintaining in principle a defence may be very difficult. If anything, many of the issues raised in this chapter may also provide grounds for contractors to claim to recover additional costs incurred. .

X. Quantum

Earlier sections have outlined individually some of the bases upon which acceleration costs might be recovered. This section reviews collectively those bases and highlights some quantum issues particular to acceleration claims. Details of costs that might be recovered as damages are not dealt with in detail here. A description of areas of potential exposure to increased costs is set out in Chapter IV and is not repeated here.

A. Contractual provisions

Where it is agreed between the parties that acceleration measures are to be taken, the contractor is usually rewarded in one of three ways: by payment of an additional agreed lump sum; by agreeing that all work to the end of the project is to be carried out on a reimbursable basis; and by agreeing to pay additional costs incurred. Examples of each are evident in different case studies. Few standard forms make express provision for these matters. Particulars will usually be set out in a supplemental agreement. There are difficulties with each approach adopted.

Lump sum payments have the advantage of being simple to arrange for the purposes of achieving agreement[375]. Consideration needs to be given to the amount to be paid, the intervals or events upon which the amount or amounts become payable, and whether the amounts will be subject to retention. In practice, agreement of a lump sum can be an area of great contention, delaying the conclusion of the agreement. Difficulties with lump sum arrangements, once arranged, are often found later during performance when sums are claimed. Defences to payment typically raised are that the underlying basis of claim is in issue (particularly where the main cause of delay now appears to be of the contractor's own making), or where further delays are incurred raising questions over whether all of the lump sum remains payable. Definition as to what is, or is not, included within the lump sum can also be a source of difference between parties. The advantage, however, of a lump sum arrangement is that the choice as to what acceleration measures are to be carried out is left to the contractor. If properly structured with identifiable and measurable objectives, the choice as

[375] Notable examples in Case Studies are JP Morgan bank and Island House Road project

to which measures are economically advantageous is for the contractor to make. Where the contractor has control over operations and resources, including design information, there can be real merit in this approach.

Agreements made whereby all work to be carried out after a particular date is charged on a reimbursable basis has the advantage of simplicity from an administrative perspective.[376] It avoids entirely the need to evaluate the additional cost of acceleration, either prospectively or retrospectively. The main problems are valuation of work on date of conversion (and with it arguments as to how claims arising before that date should be dealt with) and seeing that resources in the event are deployed efficiently. There is a danger, under arrangements such as this, that the volume of resources deployed vastly exceeds expectations and that volumes of work achieved are below expectations. There can also be an issue with staff and overheads, where much processing work that might otherwise have been carried out off site, is done on site and thus is within the reimbursable element.[377]

The most common payment method is for reimbursement of 'additional costs incurred'. This has the advantage that this formula can be agreed instantaneously, but it tends to present difficulties at evaluation stage for both employer and contractor. The contractor is at the disadvantage of not known exactly how much he might recover, or when he might be paid any additional sums. The employer, on the other hand, is likely to argue that the 'additional' amounts claimed would have been incurred in any event. That in turn can raise issues over performance and causes of delay at earlier stages of the contract. It also results difficult issues of evaluating, apart from easily identifiable costs, the additional costs arising from loss of efficiency. Additional costs becomes particularly contentious where work is carried out in different sequences, or using different methods than planned. Ultimately, an issue can arise over whether the original contract price was adequate.

Early chapters have identified a number of measures can be taken by parties to reduce difficulties with evaluation under the latter approach. These include identification of identification and isolation of a limited areas of work subject to acceleration (in lieu of the entire project); idenfitication of isolated acceleration measures; and presenting acceleration

[376] See case study for Kemsley Paper Mill.

[377] See Case Studies for both UK Paper and Sutton Bridge Power Station

instructions with conditions or limitations.

B. Are mitigation costs recoverable as Loss and Expense?

The JCT standard forms provide for the contractor to be reimbursed loss and expense incurred arising from delays caused by defined events. The provisions for extension of time are subject to the obligation, considered earlier, to use best endeavours to reduce delay. It is an open question whether costs incurred in mitigating delay ought properly to be included as loss and expense/delay damages recoverable under the agreement.

Recovery as loss and expense

In JCT98, the provision under which the contractor might potentially recover is clause 26. The relevant section of that clause reads as follows:

> 26.1 If the Contractor makes written application to the architect stating that he has incurred or is likely to incur direct loss and/or expense in the execution of this contract for which he would not be reimbursed by a payment under any other provision in this Contract... because the regular progress of the Works or of any part thereof has been materially affected by any one or more of the matters referred to in clause 26.2; and if and as soon as the Architect is of the opinion that...the regular progress of the work or any part thereof has been or is likely to be so materially affected as set out in the application of the Contractor then the Architect shall ascertain, or shall instruct the Quantity Surveyor to ascertain, the amount of such loss and/or expense which has been incurred or is being incurred by the Contractor...

This clause only allows recovery of *direct* loss and/or expense not covered by "any other Provision" in the contract. A claim can only be made under clause 26 where "regular progress" of the whole or part of the works "has been or is likely to be materially affected" by one or more of the specified events. It should be noted that the contractor must make application to the architect, i.e. the written application is a condition precedent to a successful claim. Equally a claim under clause 26 can arise only as a result of one or more of seven specified matters. Clearly there is no express provision here for recovery for delays *saved* or *avoided* nor is such recovery precluded.

An alternative view is that there is no material difference between the terms "direct loss and/or expense" and damages: see *Wraight Ltd.* v. *PH & T (Holdings) Ltd.* Recovery of damages for breach is subject to the rules of remoteness of damage as formulated in *Hadley* v. *Baxendale*[378] by Baron Alderson. Under these rules damages may be recovered as compensation for such loss as the parties may reasonably foresee as a natural consequence of the breach of contract, or as special damages. On this basis it might be argued that recovery is possible as part of loss and expense, by application of the mitigation rule as a rule of damages and if the view were taken that expenditure to avoid delay was foreseeable (to the extent that it was not excessive).

The practical application of this is complex. Taking the example (used earlier) of the two brick walls under construction, a typical outcome would be that labour from the affected wall would be reallocated to work on the other two walls but productivity on the other two walls would drop as the contractor's optimum gang sizes change. Consequently, the work as a whole would still finish a few days late overall, but not a full week late. Labour costs incurred would be slightly higher than planned and the site establishment (or time related preliminary costs) would also have increased marginally. The contractor could go further by working additional hours during weekdays and over weekends to eliminate the delay completely. Again in so doing the contractor would incur the expense of out-of-hours supervision and the non-productive overtime premium payments payable to labour. It may also be that the circumstances are such that little or no delay can be recovered.

From the foregoing several conclusions can be drawn. It is suggested that (a) contractors would probably limit exposure to additional costs incurred in reducing delay to an amount below that which might otherwise have been recovered as loss and expense absent the best endeavours (b) the level of loss and expense potentially recoverable would in any event be debatable, depending on the extent to which resources might be reallocated. The prudent contractor would put the employer on notice, at the time the delay is incurred, of the nature of losses being incurred and measures anticipated or implemented to reduce those costs. But there is nothing in the express conditions that precludes recovery of mitigation costs as part of loss and expense.

---

378 (1854) 9 Ex. 341

Limits to amounts recoverable

Keating (2001) in commenting on the proviso to the JCT extension of time provisions[379] suggests that substantial expenditure by a contractor to recover delays that are not of his making is not, is not envisaged, presumably because either it is not a natural consequence of the breach or was unanticipated as likely to occur at the time the contract was formed. If right, recovery would only be secured where the employer was put on notice before the contract was made that such an expense was likely to be incurred. Thus, where the delay is due to a matter for which the contractor might expect an extension of time and the contractor incurs expenditure in attempting to limit delays or reduce delays, recovery of that loss or expense under clause 26 may be denied on the basis that the loss or expense is too remote. But there are difficulties with this. The first is that the contractor could put the employer on notice, at the time of mitigatory actions becoming necessary, of his intention to expend substantial sums. Second, expenditure of substantial sums is arguably anticaped within the provisio as part of action in using his best endeavours to reduce delay.

It also follows, from first principles, that where the delay is the fault of the contractor, the contractor may choose to incur additional expenditure in order to reduce his potential liability to liquidated damages. The proviso only applies to delays caused by matters that are capable of being characterised as relevant events.

So far as the Contractor's obligation, under the second limb of the proviso is concerned, under which he is obliged "to do all that may reasonably be required to the satisfaction of the Architect" to proceed with the works, this, it is suggested, requires more than a general obligation "to show willing". It does not require that the contractor await the architect's instructions, merely that nothing is done with which the architect is not satisfied. Any suggestion that mitigation efforts are conditional upon receipt of an architect's instructions therefore seems misguided. If the architect were to give *instructions* under this proviso they would, it is suggested, only be valid if they are related to matters on which the conditions specifically empower the architect to issue instructions. If the contractor has any doubts as to the validity of action by the architect under this proviso he should use the procedure for querying architect's instructions given under clause 4.2. The architect has no power at all to

[379] At 18-295, page 730

tell the contractor how to do the work or to control its sequence.[380]

As Noble (1997, p293) observes, the obligation to use best endeavours recognises that the obligations are not absolute and unqualified: there is an absence of case law to cast light on the meaning of "constant best endeavours" and there is an absence of case law pertinent to contracts entered into in the construction industry. The more substantial difficulty, it is suggested, is that the provisions do not make expressly clear whether costs incurred in taking best endeavours are recoverable by way of loss and expense and leave the question as to be extent of measures to take as a matter for the contractor. This does not serve employers well, leaving them without either veto on measures taken or without a clear understanding as to which party might be responsible for additional costs incurred.

Upon further analysis, it appears that there are two distinct categories of loss that might be incurred. First, loss of opportunity claims may arise. These occur where, as a consequence of the breach, captive resources lose the opportunity to earn income, where those captive resources cannot be reallocated to other work. In this respect, the cost of labour or plant incurred over the period in question would normally be called 'standing time', that is, time spent standing idle or 'non-productive work'. Alternatively a loss arises in that the alternative use to which the resources are put earns a lower income than the use originally intended. In this respect, there is a loss of production, or loss of productivity. Securing alternative uses for captive resources might mitigate loss of opportunity costs. Labour might be allocated to other work on site or to other site. Plant might be allocated elsewhere. Alternatively, it may be impractical or uneconomical to redeploy resources in the short term.

In any event, the decision to take steps to mitigate, and steps proposed, are only likely to be taken by a contractor or employer as part of a value judgement: is it worth redeploying resources in the short term, or will problems be alleviated so quickly that it is not worthwhile? This requires information. Knowledge that a problem will be resolved in one hour will likely lead to no reallocation of resources at all. A problem known to last for the next month would demand a significantly different response. The state of the plaintiff contractor's knowledge with respect to the timing within which the difficulty will be relieved, and the value of

[380] See the uncompromising views expressed by Seller LJ in *Clayon* v. *Woodman & Son (Builders) Ltd.*, [1962] 2 All E.R. 33

redeployment in the circumstances are, it is suggested, significant factors in deciding whether steps taken to mitigate were reasonable.

The second category of loss consequent upon delay is additional time-related costs for site administration resources, large plant, site accommodation and staff that cannot be redeployed elsewhere. Such resources, dedicated to the project, probably cannot be redeployed at all in the short term. Even if redeployment is practicable, the time and costs consumed in mobilisation and demobilisation may make removal of large items of plant or site accommodation, and their reintroduction at a later date, uneconomic. Thus, where captive resources cannot be redeployed, it would seem no opportunity exists to mitigate the loss at the time of the breach. Other categories of costs incurred as a result of delay are payments to reimburse subcontractors for their losses. Clearly the contractor can ask subcontractors to alter areas in which work is to be undertaken or to postpone sections of work but that may result in subcontractors also incurring additional costs. Finance costs may also be incurred. In summary, it is clear that captive resources might be reallocated at the time the delay occurs to eliminate or reduce the potential loss. Alternatively, it may be that reallocation may be impossible, impractical, or uneconomic.

This leaves a greater question: should the contractor take subsequent action, in the acceleration phase, after the matter causing the breach has been resolved, to reduce damages? Put another way, once the contractor restarts work after the delay, should he alter the sequence of the remainder of the works in order to bring the entire project back so as to ensure timely completion? In *British Westinghouse* London Underground procured turbines from Westinghouse which, soon after installation, were found to function below specification. After a period London Underground bought new turbines from Parsons. Those turbines were so efficient that they had a high input and a lower running cost. The House of Lords made clear that purchase of those machines probably went beyond what they considered reasonable in the ordinary course of business.

Where the project is delayed by one week due to a difficulty, and subsequently work proceeds, ought the contractor to take fresh actions to reduce the delay to completion? And if he does so, which party carries the risk that the cost of so doing may exceed the damages saved? One view is that no subsequent action should be taken. If the matter that has caused the breach has been alleviated, and work proceeds again (albeit one week behind schedule), one view is that the contractor's loss has crystallised. If the loss has crystallised, and the contractor is in a position where he might seek to recover that loss as damages, should he take further steps to seek to reduce damages recoverable? This he could only do by altering the sequences of work, introduction of additional resources to work on available work and working extended working hours such as at nights and weekends. Alteration of work sequences usually means a shift away from the most economic means of undertaking activities to alternative, less economic, methods. Introduction of additional labour may result in increased numbers of labour working in confined spaces with reduced productivity. There will be an increase in mobilisation and demobilisation costs for labour and plant and productivity levels may suffer. Weekend and night working requires premium payments to labour. Each measure is likely to involve expenditure of additional sums, and involves further productivity losses. But action such as this would involve reallocation and reprogramming after the event, not at the time of the breach. That action would be entirely independent. It would not be action going to limit the damages - the damages are already incurred - but would be new action putting the contractor to new cost. There is nothing in the rule to suggest that independent action is required.

The better view, it is suggeseted, is that the requirement to use best endeavours to reduce delay invites the contractor to take independent action. Hence, that action is anticipated as likely to occur and costs incurred must fall to be recovered as part of loss and expense. Coupled with this must be the expectation that the amount involved ought to be limited by what actions were reasonable in the circumstances and were not of a character that would be beyond the contemplation of the parties. Thus, if exceptional mitigatory actions are proposed the employer should be put on notice of those in advance.

In order for the contractor to take mitigating actions, the following conditions need to be fulfilled: the progress of the works must have been delayed; the event that caused the delay is a matter for which the contract can claim both and extension of time and loss and expense; the nett effect of the action taken, if any, would be to reduce or seek to reduce the recoverable loss and expense. Suitable actions might involve isolated use of additional temporary works or resequencing part of the work in a way that did not incur significant additional cost and would not have a risk of lower work productivity. At common law, for damages to be recoverable, where action is taken to mitigate the loss, there is no particular requirement for the claimant contractor to put the employer on notice in advance of the mitigation actions taken.

Thus, it is suggested that a contractor is unlikely to take any significant steps to foreshorten the contract period after the cause of a breach has been remedied unless it was in his economic interest to do so and the steps to be taken are not unreasonable, i.e. not the type of act that another contractor would refuse to do in the circumstances. But the contractor who does take steps, acting reasonably, to foreshorten the remaining contract period to reduce time-related costs might, it seems, have difficulty recovering additional costs incurred as damages unless the employer is put on notice first of the type of action to be undertaken.

Judicial support for recovery as 'mitigation costs'

In *Ascon Contracting Ltd v. McAlpine Construction (Isle of Man) Ltd*[381] the defendant argued that the claimant should have incurred expenditure to recover delays. The argument did not succeed. Hicks J held that it was difficult to see how there could be any room for the doctrine of mitigation in relation to the damage suffered by reason of the employer's culpable delay in the face of express contractual machinery for dealing with both extensions of time and loss and expense.[382] It is submitted that these comments in so far as they relate to damages can be understood, but that no consideration was given to whether costs incurred in mitigating delays might be recoverable under the loss and expense provisions.

In *Motherwell Bridge Construction Ltd v. Micafil Vakuumtecchnik*[383] Judge Toulmin concluded that excusable delays had been incurred for which an extension of time was due. Part of the claim was for additional costs incurred in accelerating to avoid liquidated damages. Significantly, this was allowed, seen as being a natural consequence of the delays. Although not argued, it is submitted that this decision is very significant. First, the only sound basis upon which recovery has been awarded was by way of direct costs incurred in mitigating delay, lending support to the views offered above. Second, it appears this recovery mirrors the approach taken in Canada where, under *BG Checo*, followed in *Foundation*, there is now support for recovery of acceleration costs on the basis that is an 'impact cost' or mitigation

[381] (1999) 66 Con L.R. 119

[382] At 137

[383] [2002] All E.R. (D) 159; [2002] CILL 1913; [2002] 81 Con. L.R. 44

cost incurred as a reasonable response to the delays.

Conclusions:

The issue as to whether costs incurred in migation of delay are recoverable as loss and expense has not been argued in detailed before UK courts and thus remains open. Keating's view, at least, is that amounts expended on using best endeavours to reduce or avoid delay do not anticipate substantial expenditure. Neither this nor the contractual provisions preclude recovery and probably support recovery. Indeed, use of best endeavours anticipates action. It was noted, however, that some limited recognition of costs incurred in recovering delays has been made in UK and more expressly in Canada where overtime costs particularly are noted as a consequence of delay. Some further clarity from the courts in this area would be most useful.

A difficulty in mitigation related debates in relation to construction is that loss and expense discussion is necessarily focused on the contractor's costs. It should also be noted that the same mitigatory actions provides a benefit to the employer in a saving of what otherwise might have been incurred, a point not commonly noted by contract administrators or their auditors. Perceived difficulties in recovering costs incurred may also account for the low incidence of claims of this nature before the courts. A benefit-based analysis may be of some significance also in recovery on a restitutionary basis, considered next.

C. 'Quantum Meruit' claims

As was noted above, employers request acceleration, whether directly or indirectly, without agreement of the price. Assuming the absence of contractual provisions to instruct acceleration, non-conformance with conditions precedent such as putting parties on notice, or the failure to agree the price or value of the work, there has for long been much debate over whether, or on what basis, the contractor might recover. In the absence of a direct agreement upon which to sue, claims to recover costs incurred were typically made on a fair value or 'quantum meruit' basis.

It has long been the law that "when one man does work for another at his request, an implied obligation arises to pay the fair value of it".[384] As is well known, the other term used to describe the fair value was "Quantum Meruit". The underlying rationale was that a contract between the parties was implied at a law, from which sprang an obligation to pay for goods supplied or services performed, also referred to as the implied contract theory. This has been, however, an area of law where there have been inconsistent decisions. A further difficulty was that the law in this area developed in a number of narrow categories. The following is a short list of the categories in which claims have succeeded:

- Work done where contractual formalities have not been complied with: *Molloy v Liebe*[385]; *Update Construction Pty Ltd v Rozelle Child Care;*[386]

- Preparatory work or work done under a letter of intent or otherwise pending a contract where agreement was not in the event reached: *William Lacey (Hounslow) Ltd v Davis*[387]; *British Steel Corporation v Cleveland Bridge* [1984] 1 All ER 504; 24 BLR 94; *Sabemo Pty Ltd v North Sydney Municipal Corporation* (1977) 2 NSWLR 880; *Kitson Insulation Contractors Ltd v Balfour Beatty Buildings Ltd* (1991);

- Work done under an existing contract but additional work is carried out which is outside the scope of the original contract: *Brodie v Cardiff Corporation* [1919] AC 337; *Peter Keweit Ltd v Eakins Construction Ltd* (1960) 22 DLR 465; [1960] SCR 361;

- Work done under a contract wrongly terminated, or where there was an accepted repudiation; *Lodder v Slowey*[388]; *Morrison-Knudson v British Columbia Hydro and Power Authority;*[389]

[384] *Liebe v. Molloy* (1906) 4 CLR 347, per Girffith CJ at 353.

[385] (1906) 4 CLR 437; (1910) 102 LT 616 (as explained in *Rozelle Child Care*)

[386] (1990) 9 ACLR 66

[387] [1957] 1 WLR 932

[388] [1904] AC 442

[389] (1978) 85 DLR (3d) 186 - where the remedy was not available as the contractor kept working unaware of the breaches

- Work done under an unenforceable contract; *Pavey & Matthews Ltd v Paul;*[390]

- Work done under a void contract of employment due to a failure to comply with company's articles of association: *Craven-Ellis v Canons;*[391]

- Work done under a contract rendered void by a suspensory condition: *Hornibrook v Eric Newham.*

All but two of the above-mentioned decisions date from before 1986. A difficulty with cases before this date was that the rationale for award varied: there was no single rationale for award on a quantum meruit basis. A further difficulty is that some cases also involved certification. For many years the view was taken that the courts had no power to review or reopen an engineer's certificate or an arbitrator's award, leading to exploration of various means by which justice could be done. Typical of these was *Brodie v Cardiff Corporation*, noted above. In that case the contractor carried out work pursuant to the engineer's oral instructions and sums were sought for the work done. It was argued that the absence of a written instruciton was fatal to the claim made. It was held, by the House of Lords, that the arbitrator had power to award sums for extra work notwithstanding the absence of orders in writing. The House of Lord's solution lay in a generous interpretation of the arbitrator's powers under the arbitration agreement. The award of the arbitration was characterised as a decision in writing, hence fulfilling the necessary condition. Under similar facts, the Privy Council in *Molloy v Liebe*, noted above, applied an applied promise to pay solution that at the time was the understood basis of quantum meruit decisions.

In a landmark decision in that year in *Pavey v. Matthews* the High Court of Australia confirmed that the implied contract theory was an unhelpful basis to understand the law in this area. Instead, the court distinguished contractual and restitutionary quantum meruit. Under the former, where a products are services are provided in response to a request, the promisee is under an obligation to pay a reasonable sum. As *Hudson*[392] notes, a term to pay a reasonable sum is implied to give practical effect to the parties' intentions. The latter is used where no

[390] (1987) 162 CLR 221

[391] [1936] 2 KB 403

agreement exists, or subsequently comes into existence, but it would be unconscionable to allow one party to benefit from the work done or services rendered by the other. As Hudson notes:[393]

> "The distinction is of great practical importance, since the principle of restoration of benefit which is at the heart of true quasi-contract means that the resulting obligation of the defendant is to pay a reasonable price or remuneration based on advantage, if any, received by the defendant as a result of the work done or services performed. While depending on the facts, the value of the work to the defendant may in many cases be equivalent to a reasonable compensatory price or remuneration for the plaintiff, it may on the facts of some cases be less, and sometimes nil."

Restitionary quantum meruit is now considered to be a large part of the law of restitution. It is now clear that the revised basis has been accepted into English Law. By way of illustration, confirming adoption of this principle, the Court of Appeal in England in *Clarke & Sons v. ACT Construction*[394] reversed the decision of HHJ Thornton QC, who had concluded

> "...there was no contract between the parties. The parties' relationship was not a contractual one, with the consequence that the value of the work carried out by the claimant could be recovered and paid for, but on the basis of a quantum meruit, a reasonable sum, a restitutionary basis in fact".

Per Ward LJ:[395]

> "I cannot accept that finding by the judge. ...the decision that there was no contract came as a surprise. In my view, the proper construction was to find that there was, as Mr Munro for Clarke submits, "a contractual quantum meruit". In focusing on the essential ingredients for "a building contract of some complexity" the judge may have lost sight of the fact that there is no entire contract, and that especially when there is no "formal" contact, there may still be an agreement to carry our work, the entire scope of which was not yet agreed, even if a price has not been agreed. Provided there is an instruction to do work and an acceptance of that instruction, then there is a contract and the law will imply into it an obligation to pay a reasonable sum for that work. That is what happened here.

---

392 11th Edition, at 1.263, page 144.

393 11th Edition, 1.264

394 [2002] EWCA Civ 972

395 At paras 26 and 27

Since 1986 a large number of cases have helped to further define and shape the law in this area. A number of principles are emerging:

- The principle of unjust enrichment is capable of elaboration and refinement. It presupposes three things. First, the defendant must have been enriched by the receipt of benefit. Second, that benefit must have been gained at the plaintiff's expense. Thirdly, it would be unjust to allow the defendant to retain that benefit;[396]

- No action can be brought for restitution whilst an inconsistent contractual promises subsists between the parties in relation to the subject-matter of the claim: *Trimis v Misa*,[397] followed in England in *Mowlem plc v Stena Ports Limited*;[398]

- There is a clear need to distinguish contractual from restitutionary quantum meruit: *Serck Controls Ltd v Drake and Scull Engineering Ltd*;

- It is possible for a party further down the contractual line to make a recovery against another party with whom it has no contract: see *ABB Power Engineering Ltd v Chapple*.[399] In that case, a party who was acting as a subcontractor was able to recover from an entity further up the contractual chain despite the fact that no direct contractual relationship existed;

- *Concrete Constructions Group v Litevale Pty Ltd*[400] concerned, in part, a claim for acceleration costs. It was found that this fell outside the variation clause, and hence potentially fell to be valued on a restitutionary basis. However it was also found that the defendant had expected to incur liability and that it would be unjust to allow recovery.

But the precise basis upon which the claim might be quantified is still seemingly under debate. This has been raised in two decisions in England. In *Costain Civil Engineering and Tarmac v*

[396] Goff and Jones, "The Law of Restitution" 5th Edition (1998) at page 15.
[397] (2000) 2 TCLR 346; [1999] NSWCA 140; 16 BCL 288.
[398] [2004] EWHC 2206 (TTC), at para 40
[399] [2001] 25 WAR 158
[400] [2003] NSWSC 411

Zanen Dredging[401] Wilcox J made an obiter observation that recovery need not be limited to the costs incurred. In *Vedatech v Crystal Decisions*[402] Mr Justice Jacob suggested, after a review of authorities, that liability might be upon the basis of the value received, not just the costs put in.[403]

The issue has also been discussed before the Australian courts:

- *Sabemo Pty Ltd v North Sydney Municipal Council*[404] where it was noted that the court was not concerned with the state of mind of the parties in looking at values;

- In *Pavey & Matthews Pty Ltd v Paul*[405] Deane J said that the ordinary measure of restitution in quantum meruit claims will be the 'fair value of the benefit provided (e.g.; remuneration calculated at a reasonable rate for work actually done or the fair market value of materials supplied.)';

- In *Renard Construction v Minister for Public Works* (1992) 26 NSWLR 234 the Court of Appeal decided that the contractor was entitled to recover on a quantum meruit the reasonable cost (as opposed to the actual cost) to the contractor of performing the works;

- *Brenner v First Artists' Management Pty Ltd* [1993] VR 221. The main issue for consideration was whether the contract price represented a ceiling on recovery. Brenner J held (at 262) that the focus for enrichment was to be assessed from the point of view of the recipient. This reasoning has been accepted by the Federal Court in *GEC Marconi v BHP Information Technology*[406], per Finn J at Para 1415;

- In *Council of the City of Sydney v Woodward*[407] where it was said "as *Renard* make

[401] (1996) CILL 1220
[402] [2002} EWHC 818 (Ch)
[403] At paragraph 76.
[404] [1977] 2 NSWLR 880
[405] (1987) 162 CLR 221 at 263
[406] [2003] FCA 50
[407] [2000] NSWCA 201

quite plain, it is the task of the court to stand back from the evidence and to weigh up, in general terms from all the evidence before it, what is fair and reasonable amount to be paid to a plaintiff."

A different view is taken by Byrne J,[408] who suggested:

> "I suspect that in this areas of the application of the law of restitution, the measure of the relief has very little to do with the value of the benefit in this sense of the work. In my view attention should be focused, not on the increase in wealth of the proprietor nor in the value of the end result, but on the services themselves, the effort of the contractor. If this is done the task of the valuation moves to the assessment of the value of those services in the marketplace."

The issue as to how benefits are valued will be watched with interest, both in UK and Australian. This is a developing area of law but at least is clear that the costs incurred are recoverable.

[408] 13 BCL 4, at 9.

XI. Hypotheses and tests of hypotheses

The following hypotheses are anticipated and tested within this thesis.

- Acceleration is a function of a project's progress, organisation, structure and management and the environment within which the project operates.
- Management systems for introduction of acceleration to projects are underdeveloped in UK.
- Few standard forms of construction contract make adequate provision for (1) the introduction of project-wide or limited acceleration or (2) a satisfactory regime for compensation of acceleration.
- the evaluation of acceleration claims is complex: they may be valued either on the basis of cost or value. In evaluating compensation for acceleration, an analysis is required of the Project's contractual framework, progress of the progress, and the reasons why the acceleration was introduced.
- The motivation for introduction of acceleration during the progress of a construction contract differs widely between different project participants. Acceleration is percieved by auditors as revealing bad management, and hence the absence of acceleration indicates good management
- A properly developed regime for introduction of acceleration in construction contracts should include (a) a system for objective measurement of project progress; (b) a system for understanding the impact of deficient progress on the likely date for project completion; (c) contractual provisions empowering the employer or his agents to instruct changes to rates of progress; (d) a regime for valuation of claims for acceleration.

A. Tests of Hypotheses

Hypotheses have been tested using several methodologies:

- Literature Review: Much research has been carried out in reading articles, reports and papers in construction and construction law Journals; review and analysis of case law, review of text books where relevant, and through other media.

- First principles. In the absence of texts, some concepts are developed from first principles. This has aided understanding of the field and helped critical appraisal of others work.
- Case Studies. Some notes have been prepared and filed on a selection of live projects involving acceleration and with which the author was familiar. These case studies assist with understanding issues in context.
- As a final test, some matters have been further analysed in the course of work carried out by the author during research as part of ongoing claims analysis duties.

These various methods are drawn together as appropriate depending upon the material involved. As a final test, many further projects involving acceleration ~~has~~ been seen. So far as can be seen, the material reviewed and cases provided are representative of what might be found of contracts and cases typically followed in UK.

XII. Summary, Conclusions and further work

Summary:

One of the principal aims of this research was to explore acceleration on projects from a mixed perspective: that of contractor, construction professional and lawyer. This has been achieved, with a detailed analysis of the causes of acceleration, how acceleration is achieved, how agreements to accelerate are reached, which party might be responsible for acceleration, how acceleration claims might be defended and how courts in other countries have dealt with some accelerative situations. The views provided are supported by case studies from live projects and research on selected topics of relevance.

Conclusions

- Terminology used when referring to acceleration is a source of confusion, with differing conventions found between parties to a contract, design and construction professionals, lawyers, and with differences across world regions. (Chapter I)

- Acceleration is not universally required on all projects that fall into delay or where delay is likely. It is more likely to be sought on projects in delay where timely completion is highly valued, and achieving completion at an earlier date than otherwise would be the case is economically viable or necessary. (Chapter II and V)

- Acceleration is a valuable process of potential benefit to contractors and employers. For the contractor it can provide an opportunity to recovery losses or to limit further losses. For the employer it may provide an opportunity to realign contract obligations to make employer needs. (Chapters II, V and VI)

- Acceleration can be achieved by increasing the supply of resources, changing methods and eliminating constraints. Addition of resources will only increase the pace of work where the increase is to scarce resources. The prospect for successful acceleration measures is thought to be highest where specific measures are identified and where matters formerly causing delay are identified and eliminated. (Chapter III)

- Implementation of acceleration requires changes to resource deployment and changes or working methods. Those changes will impact of the costs incurred in respect of resources, but affect different resources in different ways. Hence, formulaic approaches to estimation of likely acceleration costs may be very misleading. Calculation of acceleration costs on the basis of the difference between actual costs and original contract estimation necessarily raises issues over the original planning and pricing. Acceleration may also bring about savings which should be accounted for in assessing cost impacts. (Chapter IV)

- Progress measurement and reporting systems in UK are largely developed with a view to giving a summary position, and can be very misleading when used to evaluate delays incurred and acceleration proposals (Chapter V)

- There is reluctance on the part of employers to seek out the root cause of delay and consequences of positive action before implementing remedial measures. (Chapter V)

- Acceleration should not be viewed in isolation. It is one of several time-related provisions. Those provisions, taken as a whole, provide poor support to the employer interested in evaluating acceleration proposals at the time of their proposal. (Chapter V)

- Much of the money spent by employers in accelerating projects is wasted. Costs are avoidable by selective measures and with an increase in effectiveness. (Chapter IV and V)

- The bargaining position of the contractor seeking from the employer an agreement to introduce acceleration measures is thought be very strong, largely due to time passing during the project. The range of options for recovery of costs likely to be incurred is high, ranging from a lump sum price to conversion of the entire project to be reimbursable. (Chapter VI)

- Before agreeing to any acceleration employers should evaluate and prioritise completion requirements, evaluate the potential for completion in sections; ensure the parties have a common clear as to what is meant and intended to be achieved by completion; consider the contribution necessary from the employer and designers and how it will be delivered; and consider how further delays might be dealt with. Commercial arrangements in an acceleration agreement should be evaluated in the light of these needs. (Chapter VI)

- Introduction of acceleration can increase the risk of substantial time and cost overruns. It may have been better to not to introduce acceleration at all. (Chapter VII)

- Acceleration is about securing or obtaining completion by a partical date, or minising delay, rather than merely bringing forward the date for completion. Thus, its use arises where delays damages, and liquidated damages are not sufficient for business purposes. Acceleration can also arise as a considered response to a particular issue that has or might cause delay. (Chapters II and VII)

- Treatment of acceleration in the standard forms is variable. Rarely is a bespoke provision found. Some provisions are confusing and contentious. The approach to pricing proposed variations by quotation including cost and time impact (found in NEC form particularly) potentially facilitates acceleration to limited parts of a project within the contractual machinery. (Chapter VII)

- The two approaches of constructive acceleration and breach-based claims are quite separate. The true basis of constructive accelerative appears to have been misunderstood in UK. Whether it can properly be applied in UK depends upon whether acceleration measures can be ordered or paid for under the contract conditions. (Chapter VIII)

- It is thought most unlikely that a claim for constructive acceleration, if so labeled, and made on the basis upon which those claims have suceeded in US, would find support before an English court. But, labeled in another way, acceleration costs might alternatively be recovered as loss and expense. It appears, especially from decisions in Canada (where there is little evident support for the constructive acceleration doctrine) that there may be support for recovery of costs incurred in mitigating compensable delays. (Chapters VIII and X)

- There are a number of defences available to employers faced with acceleration claims. The prospect for success for defences based upon lack of consideration, failure to take best endeavours, or failure to comply with formal requirements is thought to be low. More success may be had with causation, duress, and by raising factual issues. (Chapter IX)

This body of work is not exhaustive and contains a number of limitations:

- No attempt has been made to identify by statistical analysis the extent to which productivity of labour or other resources might drop when a project is under acceleration. It is known that others in US have attempted to review this, but a similar review in UK might usefully be undertaken.

- It was beyond the planned scope of this study to deal with computer based/algorithmic evaluation tools. Again, it is understood that others in US have reviewed this.

- Whilst key cases have been identified, this study does not deal with every UK decision where acceleration is referred, as many cases involve enforcement actions where underlying acts are not really referred to.

- No exhaustive analysis of US cases on constructive acceleration has been carried out, largely because this has already been commenced by others and due to a the large volume of material available in US dealing with time, progress, delays, agreements and evaluation of complex claims.

Contribution to existing knowledge and theories

This work aims to contribute by drawing together in one work an analysis covering several disciplines: law, construction management and construction economics. In this way it makes a positive contribution to the field in each discipline.

It also tests some theories on recovery, tests the appetite our UK courts to deal with acceleration claims and sets out a checklist of matters that an employer may seek before accelerating. This contributes to existing knowledge: some of the material has been developed from first principles; views of leading practitioners are challenged.

By drawing upon factual examples, it helps to identify areas of commonality between similar type cases and similar scenarios. It also helps to identify ranges of responses to situations, such as in structuring an agreement to accelerate or in amending contract terms.

Finally, this work highlights the potential role of mitigation within acceleration claims as a basis upon which to recover costs incurred. Whilst noted in Canada, this is explored in the context of English Law in this thesis, a field in which others have yet to comment.

XIII. Appendix A: Case Studies

A. Case Studies Summary

	Title	Main Contract or Subcontract	Building Type or sector	Acceleration instruction mode
B	National Exhibition Centre	Main Contract	Exhibition halls	Correspondence
C	De Montfort University	Main Contract	Lecture halls	Correspondence
D	Oil Refinery, Leuna	Main Contract	Process facility	Agreement
E	Barking Reach Power Station	Subcontract	Power Station	Correspondence
F	JP Morgan Bank	Subcontract	Office block	Agreement
G	The Galleries Shopping Centre (Diaphragm Wall)	Subcontract	Commercial shopping	Correspondence
H	The Galleries Shopping Centre (M&E work)	Subcontract	Commercial shopping	N/a
I	Paper Mills, Kemsley	Subcontract	Process facility	Correspondence
J	Kynn's Lynn Power Station	Subcontract	Power Station	N/a
K	Sutton Bridge Power Station	Main Contract	Power Station	Correspondence
L	Baris: Braehead Shopping Centre	Subcontract	Commercial shopping	Correspondence
M	MAFF Offices, London	Main Contract	Office block	N/a
N	Victory House, London	Main Contract	Office block	Correspondence
O	Castle Hill Hospital, Hull	Main Contract	Hospital	N/a
P	New Cement Mills, Rugby	Subcontract	Process facility	N/a
Q	Great Pulteney Street, London	Main Contract	Office block	N/a
R	Offices, Wood St, EC1	Subcontract	Office block	N/a
S	Musgrove Park Hospital, Taunton	Main Contract	Hospital	N/a
T	Jubilee line Extension	Main Contract	Railway	N/a
U	Island Crossing	Main Contract	Roads	Agreement

B. National Exhibition Centre, Birmingham

Project Description.

The project involved construction of a new exhibition hall and ancillary accommodation at the National Exhibition Centre in Birmingham, UK. The Employer was the National Exhibition Centre Ltd, a company owned by Birmingham City Council. The employer had little or no experience of building work or projects and thus was relying entirely upon the contractor and members of the design team.

In early 1986, a project controller, quantity surveyor, architect and consulting engineer were appointed. The chosen contractual arrangement was that the architect and engineer would undertake the design and a lump sum contract would be let for construction, on competitive tender, with several nominated sub-contractors. Contract conditions were based on the JCT 1980 standard form.

Three constraints are notable. First, all arrangements were to be subject to audit by the local authority. Second, the budget for the project was fixed. A fixed sum to fund the project had been secured by a grant from the European Commission. This meant that any excess over budget would have to be financed by local taxation, which at the time was politically unpalatable. Third, a large exhibition (the Spring Fair) was due to be staged at NEC in February 1989. The new hall had to be completed before the exhibition in order to accommodate exhibitors. The plan was that detailed design work would start in the second half of 1986, the main contract would be let in May 1987 and the construction would be finished within 18 months on or before December 1988.

Delays to progress of the works

Delays were incurred before construction work was let. When tenders were being sought from prospective contractors in April 1987, the design team realised that the design as it stood at that date could not be built within budget. Certain items of work were omitted and provisional sums allowed instead. The intention was to revisit the design to find cheaper solutions. Tenderers were asked to propose alternatives. A contractor was appointed in June 1987 and ostensibly contracted to complete work by the end of 1988. He had proposed an alternative form of cladding. After his appointment the design team sought to incorporate the contractors alternative proposals. This proved difficult. It required design changes to steelwork and foundations in particular. To achieve the budget the design team had no choice but to incorporate the alternative designs. Steelwork was, at the time being fabricated. The revised requirements could not be incorporated in time and resulted in delay to fabrication and erection of the entire steel frame for the exhibition hall.

By Christmas 1987, six months after the contractor had been appointed, construction was reported as being 4-5 weeks in delays. In February 1998 the delay reported by the contractor as being in the order of 8 weeks. A conventional system of progress reporting had been used whereby the contractor provided a monthly report of progress in table form against each activity. The difficulty with this, as seen now, is that little explanation was proffered against the cause of action for particular delays. The overall state of progress was not clear. Further, the extension of time sought appeared invalid to the architect: his view was that no claim was due on the sums as made.

The contractor made applications for an extension of time. This, for the project controller was unpalatable, as it would have meant that the facility would not be ready in time for the Spring Fair exhibition.

No extension of time was awarded at that time due to lack of information from which a decision could be made, apparent concurrent causes of delay for which the contractor appeared to be responsible and a difference of view as to which activities had been critical. The design team were of the view, based on the submission made by the contractor, that delays were due to difficulties of the contractors own making, so for the time being no extension of time was, or would be, granted. They complained that it was the contractor's responsibility to use his best endeavours to finish the project on time.

Why, and by whom, was acceleration proposed?

Some form of acceleration was required by the employer to ensure that the hall was completed and available for use in the Spring Fair. Indeed, exhibition space in the hall had been sold already on that basis.

The contractor suggested acceleration as a potential solution. No real details of the proposal were given. He just said that he could do it. It was required because of the employer's evident commitments already made in letting the space. It would appear that the decision was made for the contractor to accelerate based upon a low apparent cost that might be incurred: it was thought to be low as the delays were thought to be of the contractor's own making.

What was the nature of the contractor's acceleration proposal?

The contractor's progress report suggested that the project was in delay by up to 8 weeks and he suggested that he take special measures on the basis that all additional costs be reimbursed. The contractor was not asked what measures he had in mind.

What action did the employer take?

The employer's view was that acceleration on the basis of reimbursement of additional costs, from a financial perspective was not acceptable. The project controller, by a letter, instructed the contractor to take special measures to recover delays and finish in time for the spring fair. Nothing was said about money. Nor was any attempt made to analyse what areas of the project were in delay and extent of delays or causes of delay.

Although it did not become clear until the end of the project, the project controller's and design team's view was apparently that since the delays to date were caused by the contractor, any recovery was to be at his expense. The contractor's view was that he had been instructed to accelerate and for that he was entitled to all costs or damages arising. In any event, at the time the instruction was given the whole question of liability for the existing delays was not resolved.

What was the outcome?

The contractor took several steps:

- Subcontractors were instructed to, and did, introduce additional labour to the site. In the event, the additional costs claimed by subcontractors for so doing considerably exceeded all expectations.
- Completion of the works, in subsequent months, was split into sections. Those areas necessary for the exhibition were prioritised. It was soon found that those areas were inconsistent with areas defined for the purposes of sectional completion. This meant that parts of the ancillary areas were in fact required for the exhibition, so those also had to be prioritised at a late stage. This required much work to be undertaken at weekends and at night. Other the ancillary areas were not progressed at planned rates and remained in delay.
- The need to undertake temporary works in all areas to allow the exhibition to be staged was not anticipated and caused further delay to ancillary areas.

Little or no attempt was made by the employer to monitor changes in sequence and resource levels at the site. He proceeded on the basis that the problem was for the contractor to resolve. Nor was any attempt made to understand the root cause of delays.

The exhibition hall was finished just in time for the exhibition. The ancillary accommodation was not finished until six months later in July 1989. Claims were made for extensions of time for the work finished late. Significant claims monetary claims were made for costs arising from delays and costs arising from acceleration. The contractor referred disputes to arbitration and the matter was settled. The employer against the project controller and quantity surveyor later took an action in negligence. The matter was settled during the trial.[409]

Additional Comments

1. When the time span and procurement strategy was developed, little or no attention was given to (a) the risks of delay during construction and how these might arise and (b) the adequacy of the period allowed for construction given the fixed deadline and those risks.

[409] The author was engaged in assisting counsel with pleadings and generally, litigation support, analysing claims and preparation of experts' reports on time and quantum in both matters

2. When the construction contract was being let, the employer was not advised that although the contractor could just about achieve the target completion date the contract contained extension of time provisions. He was not advised that there was a risk that the project might be delayed. It appears that no attempt was made by any members of the design team to carry out any risk analysis.

3. The form of contract did not contain a power for either the employer or any member of the design team to instruct acceleration. This gave rise to considerable confusion as to the status of 'instructions' to take special measures.

4. At the time the instruction to take special measures was given, the relationship between the instruction and the existing provisions of the contract was not clear and was not clarified by any party. Further, no attempt was apparently made to clarify the roles of the professionals under the contract in the light of the instruction.

5. The contractor advanced his acceleration claim against the employer on several alternative bases: (a) that the instruction was a variation; (b) that if not express, the employer had instructed constructive acceleration; and (c) the instruction to accelerate amounted to a new a separate agreement.

6. The design team's view on progress at each stage of construction was based upon that reported by the contractor. It did not have a system established, and did not attempt, to determine for itself in any more than a superficial impressionistic way, what activities were critical to completion and which progress had been achieved and what the likely completion date might be.

7. The contractor's progress reports reported on the status of progress of construction activities that were in progress. No mention was made of those that had not commenced; no mention was made of which activities might be critical; no mention was made of the status of procurement or design where design was the contractor's responsibility.

8. The 'instruction' to accelerate was issued on what appears to have been grounds for expediency and with no analysis.

C. *De Montfort University*

Project Description.

The project was for erection of a new faculty teaching block and laboratories at the University. The building was three stories high, with lecture theatre and a feature central covered atrium in the form of a street through the building. Construction works was let on a traditional construct only basis to a general contractor. Work was due to be finished in late Summer of 1994 to allow the facility to be used from October 1994.

A large central walkway was due to be prefabricated and lowered into place in one piece through the roof void, before the roof was erected. The walkway was fabricated late (the contractor said this was due to a design change) which meant that all roof construction was delayed.

The contractor carried out progress reporting. This was done simply by showing progress against key activities and showing a summary of delay. The summary papers were impressionistic. Comments were provided with some of the activities. It was not clear which activities were critical, which were not, and which were critical. During the course of the project work fell into delay. An extension of time of 10 weeks was sought. None was granted at the time due to differing views as to what areas of the work were critical and differing views over responsibility for delay. The employer simply asked for more details in order to take a proper view on time matters.

Why, and by whom, was acceleration proposed?

It became clear to the employer that work was now only likely to be completed in Novemebr 1994. Delays beyond October 1994 would require sourcing alternative accommodation, which was not readily feasible. Hence, it was clear to the employer that some action was required to accelerate the rate of progress and bring forward the likely date for completion, to ensure completion of lecture halls by the start of the autumn term.

This was a matter of some particular concern to the university – the teaching facility was running some 10 weeks late with the result that it would not be completed by the start of term. The contractor suggested acceleration to recover delays.

What was the nature of the contractor's acceleration proposal?

The contractor suggested acceleration in two forms: first by resequencing isolated areas of work, such as erection of a chimneystack before, rather than after, installation of the roof. This was to involve extra scaffolding cost. The other measure was more general involving more labour and supervisors across the site.

What action did the employer take?

The employer's response was to accept the proposal for limited works to the chimneystack and to otherwise suggest that the contractor use best endeavours to recover delay. Work phasing was redefined. Instead of all works being completed together the project was subdivided into three sections to facilitate sectional completion. The design team were of the view that the delay to the roof was of the contractor's own making. No programme analysis was undertaken.

What was the outcome?

The contractor continued to introduce additional staff. The key lecture theatre and teaching rooms were completed on time. The remainder was finished about 8 weeks late. The contractor commenced arbitral proceedings to recover the additional costs incurred to secure an extension of time, providing relief from liquidated damages. His principal argument was found upon constructive acceleration – that he accelerated in order to avoid liability to liquidated damages and had he not done so he would finished late – on the basis that he ought to have been but was not awarded an extension of time. The arbitral proceedings were settled.

Additional Comments

Subsequent analysis showed several issues that were not clear at the time.

1. First, all progress reporting was by the contractor. The critically delayed works were not, however, those reported by the contractor. He had incurred significant delays with erection of the elevation, problems with two poorly performing subcontractors and procuring cladding panels. Thus, even if he had been awarded and extension of time, he might not have been reimbursed time-related costs incurred – costs he would have suffered in any event. The contractor's decision to accelerate was seemingly taken to mitigate exposure to liquidated damages.

2. Second, the university only needed one of the three areas being built by term start. The others might have been deferred. Time extensions might have been granted without any loss of amenity to the university. The lack of sectional completion dates, and lack of suggestion that these be introduced mid-project, was regretted.

3. The contract arrangements were inconsistent with the university's need for completion by a fixed date, for term opening. Procurement a traditional basis meant that the employer was exposed to the additional risk of delay due to defaulting consultants. In the event, it was difficulty with resolution of design details that caused or contributed to significant delay. This was a project management failure.

4. The design team advised the University, repeatedly, that all problems were of the

contractor's own making and therefore the University ought not to make any additional payments to the contractor in respect of claims. In fact this was misleading. It might have been better to advise that its views were no more than an initial impression and that there was a risk that subsequent analysis may show otherwise.

5. The employer eventually agreed that the interests of employer and contractor could best be met by completion in phases, prioritising areas needed first by the employer. In retrospect, greater control over project progress might have been achieved had these priorities been identified earlier.

D. Oil Refinery, Leuna

Project Description.

In 1993, a French Oil group (Elf Aquitane) acquired Minoil, the East German petrol station network and undertook to the German Government that it would close the existing and build a new oil refinery at Leuna, near Leipzig. The European commission agreed to make a grant of 9% of the capital cost of the new refinery project on the condition that it was completed by November 1997. Completion was not defined. The project was worth some $6bn, and was to be undertaken on an EPC basis by a joint venture contractor.

Work started on the project in mid 1994 with completion due in late Summer 1997. By mid 1996 the contractor complained that delays had been incurred: he said that the project was in delay by 3 months. At the time, the contractor showed all progress reporting in a monthly report. This report, for many months, went unchallenged. Crucially, delays to the start of many activities became evident, but no explanation for the delays was available from the contractor. Further, whilst delays to particular units of work were evident, the extent of delay to the project as a whole was not clear: the reporting template was too simplistic to convey that information. The employer suspected that delays were greater than those reported, of 5 to 6 months. Hence, he was reluctant to suggest any accelerative work as he would be paying for recovery 5 or 6 months, not just two months.

An extension of time was sought. This was considered with no award being made, initially at least. The contractor was concerned that it was not being granted extensions of time for completion so it would potentially lose completion bonuses and incur liquidated damages, and reported more delays.

Why, and by whom, was acceleration proposed?

It was apparent to the employer that failure to complete by November 1997 would result in forfeiture of the EU Grant. Some acceleration was required to secure the EU Grant. The contractor suggested that completion of the entire plant by the original date was no longer possible, but was prepared to consider, at a price, acceleration of the work. This was unpalatable for the employer in that it potentially required an admission that the delays to date were of the employer's making, a concession the employer was reluctant to make.

What was the nature of the contractor's acceleration proposal?

It was suggested that all work yet to be completed was henceforth to be carried out on a reimbursable basis and that additional resources be introduced to reduce delay.

What was the employer's decision-making process?

The contractor's proposal was rejected. Instead, the employer realised that in order to secure the EU grant, some crude oil had to pass through some parts of the refinery to produce some product. Accordingly, after some analysis, it was realised that only three of 15 units in the refinery needed to be functional and commissioned by the key November date in order to produce a heavy grade bitumen product.

In an agreement with the contractor, new Sectional completion dates were identified for groups of units (this effectively granted to the contractor an extension of time in respect of those units) and a revised date was set by which the DM50m bonus for timely completion could be earned. The net effect was that the employer was to be put to no additional cost.

What was the outcome?

As agreed, sufficient product was produced for November 1997 completion to be declared, allowing other areas of the plant to be completed later.

Additional Comments

The employer succeeded in accommodating his interests in early completion of some parts of the plant, with the contractor's capacity and progress issues, by arranging phased completion of the works. In retrospect, the employers control of the project might have been strong had this been provided for originally, stipulating units required as a priority.

The employer was aware that the contractor maintained all planning and progress data digitally but would only provide data to the employer in hard form, and in summary bar chart or S-curve manner. In his agreement with the contractor entirely new progress reporting protocols were introduced, giving the employer greater insight into progress as it progressed thereafter.

It is notable also that in proposing acceleration the contractor initially referred only to what could be achieved. No reference was made to commercial issues. It was later learnt that his strategy was to secure first an open-ended acceleration instruction, next to introduce more resources throughout the project, then to show that calculation of the nett additional cost was next to impossible and finally to suggest to the employer that it would be in the interests of all concerned if work were completed on a reimbursable basis. In the event this was not successful as a lump sum arrangement was achieved. It is, however, evident that contractors on other projects have attempted similar tactics.

E. Barking Reach Power Station

Project Description.

The project was for construction of a new CCGT power station at Barking, Essex, along the Thames Estuary. Part of the work involved fabrication and assembly on site of condensers. These contained extensive pipework that was fabricated and installed by a subcontractor.

Why, and by whom, was acceleration proposed?

Extensive delays occurred during fabrication of pipework, and the subcontractor sought extensions of time from the management contractor. Delays to this pipework threatened to delay completion of the entire plant. The main contractor alleged that all delays to date were of the subcontractor's own making. A key problem was that all progress reporting, which the contractor was leading, was shown in summary form only and without any explanation as to what was causing delay. Hence, delays had been incurred but no explanation for the delays had been sought at the time. This led to confusion over the causes of delay, the extent of delay, and the likely date for completion.

Without any express mention of acceleration, considerable pressure was put on the subcontractor to bring additional resources to the site to achieve planned progress. This pressure was noted in meeting minutes, upon which the subcontractor later placed great reliance in pursuit of claims to recover costs. The subcontractor agreed

What was the nature of the contractor's acceleration proposal?

The subcontractor brought additional resources to the site as requested, and later sought to recover additional costs being incurred through this. All costs claimed were denied. .

What was the outcome?

After completion of the work, a significant dispute developed between the parties. The contractor sought to recover the cost of the additional resources brought to site; the employer was of the view that these resources were always required. The parties had no clear views on responsibility for earlier delays. The dispute was settled during proceedings, after a detailed review of the causes of delay.

Additional Comments:

It is striking how the subcontractor commenced extensive actions of bringing more resources to the site without any discussion of commercial issues. It was later learnt that the contractor, on other projects, had acted similarly, dealing later with commercial issues with a view to converting all payments to be on a reimbursable basis. This pattern is similar to that seen on the Leuna case noted above.

F. JP Morgan Bank

Project Description.

The project involved construction of a new office block in London for JP Morgan, the US based investment bank. The project was substantial, involving construction of two linked buildings, one 10 storeys high, with construction costs exceeding £100m. A multi-disciplinary practice acted as architect and engineer, a separate quantity surveyor was employed and construction was undertaken through a management contracting arrangement. Bespoke contract conditions were drafted for both management contract and works contracts.

The high voltage and low voltage electrical work for both buildings was let as a single package to one works contractor. Tenders were invited in January 1989 and the contract let in early March 1989. At this stage, detailed design was still under development. According to the terms of the works package as agreed with the successful tenderer, work was to start in April 1989 and continue for 77 weeks. Due to the scope of the package, sequence of work of preceding trades, and configuration of the buildings, the work needed to be undertaken on each level as working areas became available: thus work electrical work might be proceeding on many levels and in many areas concurrently.

Work started on most levels later than planned due to delays with preceding activities and did not proceed according to plan. Some areas were subjected to design changes and work proceeded slowly as the relevant design information was not issued in sufficient time. In some areas work could not proceed at all as several areas were 'on hold' pending redesign, and the anticipated sequence of work could not be followed.

Progress reporting

Why, and by whom, was acceleration proposed?

The management contractor needed the project to be completed on time in order to avoid incurring delay damages. He suggested to the employer that the delays could be recovered through 'reprogramming' although this was not explained.

In December 1989, with work some 13 weeks in delay overall, the management contractor issued an instruction to the works contractor for certain areas to be accelerated. For this the works contractor was paid some £300,000. By March 1990 progress had deteriorated further, with the result that the project, instead of accelerating, was now even further in delay.

What was the nature of the contractor's acceleration proposal?

The works contractor suggested acceleration of the entire works package

What was the employer's decision-making process?

The contractor's proposal was rejected. Instead, a new arrangement was reached between the management contractor and works contractor, recorded in a supplemental agreement, which dealt with several matters. First it was agreed that an additional £350,000 was to be paid to the works contractor. This sum, together with the previous sum of £300,000 were said to be in full and final settlement of claims which had been made by the works contractor for delays up to that point. Second, it was agreed that the contractor could advance no further claims in respect of matters "the causes of which had manifested themselves to the works contractor up to 31 March 1990...". Third, the management contractor issued a new target programme which contained a series of target completion dates in respect of different areas of the project. In respect of each it was provided that a further bonus sum would be payable if the target was met. In return, the works contractor undertook to take special measures towards meeting these dates. The agreement also provided that the new dates were to replace the original contract completion dates and provision was made for granting extensions of time.

What was the outcome?

Further delays were incurred and work was finished later than envisaged under the revised dates. The works contractor sought payment of an additional £2m in respect of costs said to have been incurred. Proceedings were commenced to recover the sums in question. Liability was in dispute due to differing views with respect to the cause of later delays, timing of those causes and hence responsibility, and quantum of the additional costs incurred. The works contractor asked for the lump sum agreement to be set aside. The matter was eventually settled by payment of substantial sums by the employer.

Additional Comments

1. The fundamental problem was that work was procured on a basis whereby the subcontractor's primary obligation was to complete by a single date. In fact, progress at intermediate stages was crucial to progress of other work. There was no effective sanction for failure to complete sections by intermediate dates. It is noted that in the event completion was secured to the employer's satisfaction by prioritising for prompt completion particular areas of the project.

2. The acceleration agreement sought to deal with past causes of delay. In fact, there were many causes of delay, many of which the contractor had not yet reported. Accordingly, upon the occurrence of subsequent delays there was both confusion and debate over the date the cause of delay became apparent.

3. The employer's approach, on the advice of the management contractor, was to enter into an agreement that dealt with responsibility and liability for earlier delays and paid a lump sum by way of compensation. In fact, that approach was misguided. The causes of delays were largely twofold. One was due to poor

performance on the part of one of the other subcontractors. Another was poor performance on the part of both management contractor and design team. The acceleration agreement alleviated none of these problems.

G. The Galleries Shopping Centre (Diaphragm Wall)

Project Description.

The project involved demolition of buildings and construction of a large shopping mall in Bristol city centre. The project was carried out on a construction management basis. The work was planned to cost £78m and to be completed within 2.5 years. Work started on site in July 1986.

Why, and by whom, was acceleration proposed?

Eight months after work started on site, work was some 3 months late. The critical activity being undertaken was construction of a diaphragm wall. This was originally due to be installed in a clockwise direction around the site, ending at the least important area. Difficulties with site acquisition meant that the sequence had to be altered and work fell into delay. The construction manager's report in February 1987 showed package start and finish dates and showed diaphragm wall work was likely to finish 3-4 months late. In March 1987 the Construction manager suggested limited acceleration of this package so as to recover delays.

Progress reporting

What was the nature of the contractor's acceleration proposal?

Acceleration of the diaphragm wall package was proposed. In fact all this meant was that the last 25% of the wall was to be installed within 8 rather than 12 weeks.

What was the employer's decision-making process?

The employer followed the recommendation of the construction manager without undertaking any analysis of alternatives.

What was the outcome?

The diaphragm wall work was completed within the shorter period. This, however, had no effect on the extent of delay to the project as a whole, as completion of the diaphragm wall work was not critical.

Additional Comments

The construction manager's justification for acceleration of the package was secure completion of the Diaphragm walling on time. Progress bar-charts, which showed only the start and finish dates for large packages of work, this gave the impression that work on site was progressing largely to programme. Had focus instead been upon the crucial work in the southwest corner of the site, it would have been clear that work was 3-4 months in delay and delays were increasing. Poor progress reporting systems allowed both a busy project manager and naive client believe this acceleration effort would help secure a timely completion. What later became evident was that the construction manager was focusing heavily on performance of individual trade contractors. This was a management failing. The focus instead should have been upon what action might have helped performance of the project as a whole.

H. The Galleries Shopping Centre (M&E work)

Project Description.

As above

Why, and by whom, was acceleration proposed?

The M&E trade contractor was appointed in mid 1998. The first work undertaken was production of drawings and laying conduit in floor slabs as they were being laid – a minimal role. The substantial installation was to be begun once blockwork walls were erected, underfloor fire protection installed and floor screed work done. All of this work was delayed. In response, the trade contractor said he could not start on site until he had a clear space to work, which would delay completion of his works by three months. He suggested that his entire package was accelerated.

What was the nature of the contractor's acceleration proposal?

The proposal was that he could bring forward his likely completion date by two months for a premium payment of £0.6m. This was conditioned upon having all design information available.

What was the employer's decision-making process?

The employer, on the construction manager's recommendation, accepted the proposal. At the time, the trade contractor had just started work on site, was threatening to stop altogether and his work was critical to completion. The employer felt he had little choice but to accept in view of the late start of the work on site.

What was the outcome?

The outcome was very favourable to the trade contractor, in that he had effectively secured an increase in his contract price of £0.6m before work even started on site. Further, the trade contractor's preferred method of carrying out the work was to await receipt of as much information as possible, await availability of as many work areas as possible, and then to start on site carry out a large volume of work in a short period. This he was seemingly able to achieve, having complained that lack of information had prevented a start on site. But in the event, the trade contractor's work did not proceed well. It was adversely affected by lack of design details and by a failure on the part of the design engineer to resolve technical issues promptly. The trade contractor's work was delayed by several months. In the face of further delays an arrangement was again reached that was directed at completing a large volume of work within a short period. This was largely achieved. From the employer's perspective, two premiums were advanced to the trade contractor, on the construction manager's recommendation, although work was still completed late.

Additional Comments

The action recommended by the construction manager was directed at improving performance of one key package. The consequences, however, were not properly considered. No attention was given to understanding the state of design information available to the trade contractor, and no attention was given to the impact on other trades of larger than planned large groups. This was to be delay other works, and ultimately delay the later stages of mechanical and electrical work. Action taken with respect to one package did not particularly favour the project as a whole. This was a management failing.

I. Paper Mills, Kemsley

Project Description.

A new pulp processing and storage plant was to be built in Kemsley, near Sittingbourne in Kent. The project was lead by a leading American engineering contractor who was undertaking design, co-ordination and construction supervision of all construction through direct works packages. The project was extensive and involved complex pipework installations for the process sections. Materials were to be sourced by the engineering contractor and supplied free-issue to a pipework contractor for fabrication and subsequent installation.

Progress reporting

Why, and by whom, was acceleration proposed?

There were delays with material supply. This, said the pipework contractor, caused delay to ongoing fabrication work amounting to almost two months: it would change the dates by which variations sections were fabricated, and would require a different erection sequence to maintain progress. The more intermittent and prolonged installation work would require more time and money. Extensions of time were sought. He suggested that his entire contract should be undertaken on a different basis to ensure that delays were recovered. Coincidentally he threatened to stop all work on site until he was properly reimbursed additional costs being incurred as a result of the stop-go nature of the work. In response, the employer suggested that all delays were of the works contractor's own making. Notwithstanding this, the employer was very keen to see that the project as a whole was not delayed by poor performance on one works packages.

What was the nature of the contractor's acceleration proposal?

The pipework contractor suggested that all subsequent work was undertaken on a reimbursable basis, as this was the only way that the contractor could be properly reimbursed.

What was the employer's decision-making process?

The employer acceded to the pipework contractor's request, on the advice of the engineering contractor. The decision was made on the basis an estimate that costs to complete would be some 10% higher on this basis.

What was the outcome?

The pipework contractor introduced extra labour and plant to the site. The level of payments were then disputed on the basis of differences between parties with respect to expected level of expenditure, the extent of work that had previously been done and time required to complete or to undertake variations. Disputes also arose with respect to the causes of delay, whether the delays had been as bad as predicted by the pipework contractor. In the event the final account was 140% higher than the contract sum and there were very significant disputes over recover.

Additional Comments

It later transpired that the pipework contractor's tactics were not deployed solely on this one project. They involved a pattern of securing an order on the basis of a letter of intent, but seeking to challenge for as long as possible some contract conditions. Further, once approximately 30% of progress had expired and considerable advance had been made with production of working drawings, the contractor would advise of the impossibility of achieving the contract completion date, and seeking all work to be converted to be undertaken on a reimbursable basis.

It appeared that little detailed thought had been given to the consequences to the employer of the Acceleration deal achieved. The main assumption, which proved false, was that the cost of completing the work would be broadly consistent with the contract price. This was fallacious for it failed to account for delays by others, delays by events such as weather, premium time payments, a drop in efficiency due to a large labour force, increased supervision and consulting engineer's fees, and responsibility for risk in the event of another delay.

It is questionable able whether, on the facts of this example, a claim for economic duress by the employer might succeed on the strength of the lack of any practical alternatives felt by the employer.

J. Kynn's Lynn Power Station

Project Description.

The project involved construction of a combined cycle gas-power generation station in Norfolk. Part, to be undertaken as a separate package, involved construction of a water cooler and raised air-cooler condenser. The engineering contractor designed the installation, procured materials direct and arranged for installation via subcontracts. Hence, the subcontractor was to erect the steel frame supplied to him, and would design, fabricate erect and complete the balance of the work to the air-cooled condenser. This structure was sizeable, at some 30m square.

There were initial difficulties due to late delivery of the correct steelwork, in the correct sequence, to accommodate the installation contractor's method of working. Within three months on site, work fell 6 weeks into delay. An extension of time was sought.

The employer was reluctant to grant an extension of time, for several reasons. First, late completion of these works might delay completion of the master contract, which would in turn mean that the main contractor would withhold liquidated damages. Second, it was by no means clear whether, or to what extent work was in delay: a conventional progress reporting system had been adopted, ie paper based, and published with little or no commentary as to why progress to date had been poor. Further, there was no indication as to where the critical path lay, which activities had been critical during the periods of delay and which henceforth were critical. On the whole, the progress position was confusing.

Why, and by whom, was acceleration proposed?

The employer immediately declared that no extension would be granted, so as to maintain the original date for completion. But in doing so the main contractor conceded to the subcontractor that some completion requirements were to be relaxed, in that the only work needed for completion was that required for mechanical completion. All other signage, safety rails, roof cladding and commissioning work could be completed later.

What was the nature of the contractor's acceleration proposal?

The subcontractor suggested that by some reprogramming, and use of specific additional resources he might be able to secure a timely completion. As part of this deal, he also suggested that all subsequent work be undertaken on a reimbursable basis. This proposal the employer dismissed. Instead, the subcontractor suggested that a premium be paid for introduction of specified resources, chiefly a crane, supervisor and more site huts.

What was the employer's decision-making process?

Little or no attempt was made by the employer to review the actual state of progress. Instead, he had a larger problem. To the extent that he finished late he would have to be pay liquidated damages to the employer. He desperately needed a commitment from the pipework subcontractor that he would endeavour to complete on time. The employer was content to pay the lowest possible premium to secure completion by the due date and thus readily agreed to the introduction of the limited additional resources.

What was the outcome?

The subcontractor's additional resources were added subject to conditions, one of which was that design details would be resolved and materials for incorporation into the works were incorporated on time. In fact there were ongoing design difficulties that needed to be resolved and that caused some significant delay. Notwithstanding these, the employer insisted that completion by the original completion date was achieved. In the end, the subcontractor achieved completion of the key parts of the plant within two weeks of the planned date for completion in order to allow testing of the whole plant. But other ancillary works remained outstanding that those ancillary works were not completed for many months.

At the same time a substantial commercial dispute emerged with respect to whether the subcontractor was entitled to recover additional costs incurred in attempts to complete key areas of work by the contract completion date, and if so, on what basis recovery might be allowed. Although the contract sum was only in the order of £620,000 the total sought exceeded £1.4m. The dispute, referred to arbitral proceedings, was eventually settled during the trial.

Additional Comments

It is notable that the agreed acceleration proposals involved splitting the work to be done. Some was critical for completion, the balance was less important.

Second, much consideration was given to additional direct costs likely to be incurred. Little or no discussion was given to efficiency with which the balance of the works might be executed, and the need for supervisions.

Third, the acceleration claim was made on the basis that it was necessary to accelerate having regard to previous delays. This in turn required the contractor to explain, in some detailed the delays have been already incurred, a matter that the contractor had not appreciated.

K. Sutton Bridge Power Station

Project Description.

The project involved construction of a combined cycle power station just north of The Wash on the East coast of England. A single engineering contractor was engaged to undertake engineering, procurement and construction supervision. Installation was to be carried out entirely by trade contractors that were to be engaged directly by the employer.

Why, and by whom, was acceleration proposed?

The project suffered a number of difficulties. One package involved design, and fabrication and supply to site of heat recovery steam generators (HRSG). The date of their planned delivery to site was delayed due to design and specification difficulties. A subsequent issue concerned the extent of fabrication that was to take place off-site. The engineering contractor and installation contractor understood that the HRSGs would come to site in very large prefabricated units, which would facilitate easy installation. But supplier supplied these in small components, greatly increasing installation time required on site. The late fabrication and erection of these threatened to delay in the entire project.

In addition, the engineering contractor's design of pipework was found, by internal audit, not be cost efficient compared with other schemes worldwide and was redesigned. This also affected HRSG design.

Whilst progress reports suggested that work was largely proceeding to plan, the engineering contractor suggested to the employer that the project was running late due to late delivery of the HRSG, a matter for which that supplier was responsible. Despite delays, the contractor took the view that the date for completion had to be achieved, and that measures should be taken to accelerate progress to achieve the original completion date. The employer was not fully appraised of the likely cost or consequences of this decision.

What was the nature of the contractor's acceleration proposal?

No detailed proposals were presented.

What was the employer's decision-making process?

The employer's primary concern was to see that the plant was finished on time. He was prepared to postpone until project completion the question of responsibility for delays or appropriateness of the employer's decisions. No attempt was made to analyse progress to date or likely date for completion.

What was the outcome?

Many of the other trade contractor's works were repackaged and reprogrammed in an attempt to secure timely completion. Some were converted to a reimbursable basis of payment, and some were split so that other contractors could be introduced. In the event work finished some 4 months late, with cost overruns in the order of £22m, and proceedings to recover cost overruns and delay damages were commenced against the engineering contractor.

Additional Comments

The employer was poorly represented during the project. Other than the engineering contractor he had no source of independent advice. Progress reporting, in particular, was undertaken in S-curve format, and the baseline against which progress was measured had been changed on several occasions during the project. This had several implications. Delayed had occurred early in the procurement and detailed design stages that had not been reported or whose impact was not reported. Other reported delays had gone unchallenged as had changes to baseline programmes. In fact the methodology for progress evaluation was changed to suit the circumstances, with a tendency by the contractor to only report delays when a 'non-culpable' explanation was available.

The acceleration measures proposed were termed, at the time, reprogramming. A focus on project completion resulted in the need to realign the contractual provisions of many trade contractors with the revised completion. The employer had no mechanism in place to either assess or understand what measures were being taken to alleviate delay and no mechanism to gauge the likely extent of package cost increases.

L. Baris: Braehead Shopping Centre

Project Description.

The project involved construction of a Shopping centre in Glasgow. Work was undertaken on a management contracting basis. The management contractor was Bovis.

Why, and by whom, was acceleration proposed?

Construction of the project ran late. Bovis applied for, but was not granted the extension of time it required. The extension of time was not refused. It was merely that in the circumstances at the time the architect was not convinced that more time was due and sought to decide late. The exact state of progress was not clear in any event. It was clear at the time that one particular works contractor was in default, and it was that default that was delaying progress of the works. Bovis suggested that acceleration measures were taken to reduce delay.

What was the nature of the contractor's acceleration proposal?

The proposed measures were not discussed with the employer in any detail. The strategy was described as being first to reschedule and second to 'programme push'. Meanwhile Bovis commenced discussions with works contractors with respect to means by which works might be rescheduled. This involved working longer hours, (for which the non-productive overtime premium would be reimbursed), and making arrangements for additional teams to be introduced in order to allow work to proceed in many areas concurrently.

What was the employer's decision-making process?

The employer listened to the contractor's proposals but made no commitments to them. He advised that should the contractor wish to proceed, he would have no objection. So far as additional costs were concerned he suggested that these "would be considered".

What was the outcome?

Bovis seemingly understood the employer to have agreed to reimburse additional costs incurred so far as the amount claimed was reasonable. It subsequently emerged that the employer's expectation was that rescheduling would involve virtually no additional costs being incurred. The works contractors made substantial claims for reimbursement of additional costs arising from rescheduling of the works. Part of the difficulty was that works contractors spread resources over a wider area of the site, and had to work around other trade contractors. The efficiency with which the work was carried out quickly fell. The work that was critical to completion was also delayed. The project finished late. Part of the delay was due to poor productivity suffered by contractors due to the so-called special measures. Substantial claims were made by the works contractors against Bovis and by Bovis against the employer. Some proceeded to litigation.

Notable issues

Construction managers have several interests to manage: on the one hand is an interest in seeing that each trade package is completed within its planned duration and to a fixed budget. This objective can lead to acceleration measures being taken on individual packages. The second interest is to see that the project as a whole is completed on time. It is notable that packages can therefore be accelerated with no impact at all on the project progress at all if those are not critical to completion. It was notable that more attention was typically given to timely package performance, as occurred here, to overall performance.

M. MAFF Offices, London. Ballymore Phase 3

Project Description.

A developer bought a group of suite of buildings that once housed a central London hospital. Each of the main blocks was to be redeveloped. The old nursing home was a concrete framed building that was to be stripped out leaving only the frame and refitted for use as offices. Just after letting the first construction contracts for refurbishment the developer completed an agreement for lease with a government department. This was to include a full office fit-out.

The developer, who was also acting as construction manager, procured curtain walling later than planned and its detailed design work (which was being undertaken by the trade contractor) showed very poor progress. The developer was determined to at least give the impression to the lessee's advisors that work was proceeding to plan when it was in fact in delay.

Why, and by whom, was acceleration proposed?

The construction manager's strategy was to achieve practical completion as planned. In order to achieve this he decided to pre-programme work, by allowing internal work progress earlier that might otherwise have been desirable given the incomplete state of the curtain walling installation and to use of temporary works to keep each floor water tight so as not to damage installed finishes.

What was the employer's decision-making process?

The lessee's advisors seemingly did not notice the change of strategy and made no observations.

What was the outcome?

There were several implications. Proceeding with internal work in advance of completion of curtain walling and dry conditions was a high-risk strategy. But the developer knew that he would not be responsible for any delays during the fit-out period, and thus expected the fit-out works (which were being specified by the lessee's advisors) to run late, thereby providing time to allow the envelope to be completed. An attempt was also made to redefine what work needed to be complete for practical completion to be certified. Some work was deferred until after PCC as a means of reducing potential exposure to liquidated damages.

As expected, work ran late and the developer suggested that all delays were generated during the fit-out stage. Two significant disputes arose. One was that the leasee expressed grave misgivings with respect to the state of completion when practical completion was declared. The lessees view was that the building was not yet fit for occupation, but occupied in any event under protest. Second, reprogramming work internally meant that exposure to claims from finishes contractors and M&E subcontractor affected were significant. Despite disputes between the parties, matters were comprised at an early stage in the developers favour.

Additional Comments

This project provides a useful illustration of how employers can let work continue without noticing (or expressing a view on) a change to the way the work was being carried out. In this instance the contractors voluntary acceleration efforts were successful. By use of temporary boarding/sheeting, the difficulty with delayed shipment of cladding was largely avoided at the time. But the revised construction sequence adopted also put the employer at greater risk in that delays to completion, should any delaying event arise, would probably have a greater impact on progress than would have arisen before the accelerative actions, or the weekly delay costs were higher.

N. Victory House, London

Project Description.

The project involved relocation of a government body from one building to another. The move was required as the lease was due to expire within 18 months and the building was due for redevelopment. Before occupation the new offices required substantial upgrade and fit-out works. The budget available was limited. It was imperative that the new site was occupied by January 1998, as the old office had to be vacated for redevelopment.

The refurbishment of the office to be occupied, at Victory House, Kingsway, London W1 was undertaken in two phases. The first was for stripping out furniture and fittings and removing structural elements so as to leave only the mere frame, floors and external walls and stair/lift zone. The second phase was installation of all new works.

The first phase proceed without much difficulty. During this work an contractor was selected for the second phase that was to follow immediately. In the end the same contractor ended up with responsibility for both phases, albeit under entirely separate contracts. The first phase finished more or less on time.

During the second phase a variety of difficulties were encountered. The Contractor said that work undertaken during phase 1 was inadequate, so that more was required in phase 2. Meanwhile delays were incurred due to late resolution of design details and poor performance on the part of the contractor.

Why, and by whom, was acceleration proposed?

The architect suggested all delays were the contractor's fault. Pressure was put on contractor to complete on time. The contractor suggested that special measures were taken to achieve timely completion.

What was the nature of the contractor's acceleration proposal?

The contractor made clear that to achieve timely completion his subcontractors would work late and work over the Christmas period. He suggested also that certain works were to be completed after the completion date, as 'post-completion' or 'retrofit' works. As further delays were incurred he also suggested that the employer should taken partial possession over three weekends, that is to say that work was completed in stages.

What was the employer's decision-making process?

The contractor was implored to do his best. No agreement to pay additional costs incurred was made. He explicitly noted at the time that acceleration was not being instructed. By Christmas 1997 the employer had given notice to quit the building he was leaving. He was committed to moving out in full by end of January 1998. Accordingly he had no real alternative but to agree to retrofit works and to agree to occupation of the building progressively.

What was the outcome?

The new offices were occupied progressively. This drew bitter complaints from the occupiers, as attempts to settle in were further disrupted by the retrofit works. In the event, contractors did not finish work until April 1999, some 3 months after the 'latest' date for completion.

The contractor made both disruption and extension of time claims. Detailed analysis of the claims reveal that the disruption claims were in fact for acceleration, a matter for which the employer had said during the project he was not prepared to pay. A settlement was reached, so that the employer eventually made a contribution to acceleration costs. The contractor's rationalisation of the settlement described acceleration payments as being disruption, in order to avoid embarrassment over explanations. Subsequent actions are taking place against professionals regarding design performance, instructions to accelerate provided without authority. .

Additional Comments

The employer relied upon the contractor's progress reports and summaries of progress. These were presented in a summary form with little explanation offered as to what was causing delay. This generated considerable confusion on the part of the employer and design team in evaluating time required to achieve completion.

No real attempts were made to analyse the state of progress on site. Had any analysis been undertaken, it would have been clear that (a) the state of progress overall, if regard is paid to the critical activities, was worse than reported and (b) had the employer known the true position he could and should have negotiated with the Freeholder of the building to be vacated that he would need to remain for a few month or two. This the employer did not even consider. Equally the project manager made no allowance for possible failure to secure timely completion.

O. *Castle Hill Hospital, Hull*

Project Description.

The project was for construction of a new maternity wing for a NHS hospital in East Yorkshire. A conventional procurement arrangement was used. In accordance with NHS guidelines, the completed designs were signed off before work started on site.

Why, and by whom, was acceleration proposed?

During foundation works site activities fell into delay by about three weeks. The contractor applied for an extension of the time, and the architect was not prepared at that stage to say whether or not an extension would be granted. The contractor put to the employer a proposal for recovery of the delay.

What was the nature of the contractor's acceleration proposal?

The first proposal was detailed, and limited specifically to certain measures. These were that the steelwork contractor would introduce an additional draughtsman and a second erection team; the concrete subcontractor would introduce an additional two men, the roof carcassing contractor would hire two extra ladders and two separate teams rather than one would do tiling. This would also, for some, involve late night work. The precise period of additional resources was stated. This was all offered for a lump sum, for which a detailed build-up was shown.

What was the employer's decision-making process?

The employer was nervous and realised that there was a risk that the architect would issue the extension. He make an agreement with the contractor whereby the lump sum would be paid in return for the resources as planned, and the contractor's agreement that any causes of delay arising before the deal would not subsequently be used as grounds for delay claims.

What was the outcome?

The acceleration was implemented and some, but not all work within the following 8 week acceleration period was completed within the shortened period. During this period, no delays or difficulties were recorded. Immediately afterwards delays were recorded as and when the contractor found grounds upon which the delay might be said to have arisen.

The contractor suggested further acceleration but this was not accepted. The contractor said he was taking special measures in any event, and later sought to recover the costs incurred in a variety of ways. Work finished 8 weeks late. Disputes over the value of the final account were settled several years later.

Additional Comments

The employer managed to secure, as part of the initial acceleration agreement, the contractor's agreement to drop all claims to date. This was remarkable, for the contractor's proposal had been pitched merely as an arrangement to bring on more resources, without any guarantee that this would be effective.

In the event the contractor sought to argue that internal work that was accelerated was completed by the foreshortened plan, but studiously ignored external works and roof works. The reality was probably that work was considerably in delay, and a watertight envelope was needed to allow work in plant rooms to proceed. The employer failed to realise this, and in subsequent disputes regarding extensions of time due to internal problems the employer focused on internal works, ignoring critical envelope and plantroom work. The result was confusion over extent of actual delay and delay claims later formed the cornerstone of arbitration proceedings against the employer. Those proceedings settled on terms largely favourable to the employer, but the employer felt obliged to pay a premium for the convenience of securing an early settlement.

P. New Cement Mills, Rugby

Project Description.

The project involved design and erection of a new cement processing facility and storage facilities. A construction manager undertook detailed design, procurement and construction management. Work packages were let directly with the employer. A specialist supplier designed the mechanical process and supplied the mechanical equipment, ductwork and pipework. The project overall was to be completed within 24 months.

Why, and by whom, was acceleration proposed?

Delays were incurred at early stages of the project. The specialist supplier supplied process drawings later than planned. Steelwork erection was very slow to progress. The construction manager was keen to avoid liability to liquidated damages to the employer and implored the steelwork contractor to increase the pace of work. This was not reported to the employer until a month later, when the employer's consent was sought to accelerating to recover delays.

What was the nature of the contractor's acceleration proposal?

The contractor merely asked the employer if he would agree that acceleration to recover delay was appropriate. No particulars were given as to what this involved other than 'rescheduling'.

What was the employer's decision-making process?

At about the same time the employer engaged two individuals to prepare a brief project audit. Their conclusion, after a few days work, was that the project was generally proceeding well and to budget. The employer was of the view that completion by the target completion date was crucial and therefore the acceleration was necessary. Neither employer nor contractor raised the issue of potential exposure to additional costs. The employer agreed to the rescheduling, and understood that this would bring the project back on schedule.

What was the outcome?

Further delays ensued and the value of individual packages vastly exceeded contract sums. In an effort to overcome further delays the construction manager convinced the employer that new contractors were engaged to undertake some parts of the works, which increased costs further. Difficulties with completion of the work meant the project finished 4 months late. The construction manager sought to blame all delays on the specialist process supplier and sought an increase in the target price to enable bonuses to be earned.

Additional Comments

Other than cursory examination of a monthly progress report, no other analysis or investigation was undertaken by the employer to understand either the true progress position or the causes of delay. The analysis undertaken by the audit team was too superficial to be of any use. He saw the construction manager as the party best charged to provide that information. That no attention was given to either the risk for further delays or the risk of reschedule-induced cost increases was indicative of poor project management.

A somewhat wider problem was founded in the way the project was set up. At inception, that the budget was not exceeded was declared to be crucial to success of the scheme, even imperative. When a new chairman took control of the employer's business after work had started on site, and in the face of potential delays, the date for completion was viewed as being sacrosanct. Curiously no thought was given to whether that might mean that the employer might be exposed to additional cost.

Q. Great Pulteney Street, London

Project Description.

The project involved partial demolition and redevelopment of a former city centre post office as a new office block for a commercial developer. The project arrangement was conventional, involving employer led design team, main contractor and subcontractors.

Why, and by whom, was acceleration proposed?

The project ran late, initially due to difficulties with unanticipated existing foundation structures an incorrect survey. Later further delays were incurred due to a revised fireproofing specification for existing floor soffits and unanticipated alterations to the existing façade structure before the new brickwork façade was fixed. Work was predicted to be some 22 weeks late. The contractor proposed acceleration

What was the nature of the contractor's acceleration proposal?

He indicated he could complete the project within 18 weeks for a premium. No details were given as to what actions might be taken to achieve this, other than working at weekends.

What was the employer's decision-making process?

The employer found it difficult to decide, as the architect had not given a view on the extension of time due, and was not prepared to discuss the matter with the employer. The employer was hoping to agree to settle all claims, including acceleration for a lump sum, but his attempts to do so were thwarted by the untimely award of an extension of time for 18 weeks 'with costs'.

What was the outcome?

In the event the contractor completed the work within 18 weeks. Either the statements with respect to likely date for completion (22 weeks late) were pessimistic and were made in the hope of securing a premium to 'accelerate' when no acceleration was in fact required; or the contractor did accelerate and chose to do so in order to avoid liquidated damages. Effectively the contractor had been awarded an extension for 100% of the period of delay and did not pursue any acceleration related arguments.

Additional Comments

The contractor might have argued (a) it was entitled to a greater extension and (b) accelerated in order to finish when he did. It appears that argument was not pursued because insufficient notice was given during the project that the contractor might be entitled to extensions of time; there were many matters for which the contractor was responsible and he was surprised to have been awarded as great an extension as he did; and the chance of securing any payment in respect of acceleration from the design team or employer without any express order to accelerate was very low without litigation. Litigation was not worthwhile given the sums involved.

R. Offices, Wood St, EC1

Project Description.

Ibex, a main contractor agreed with the employer Friends Ivory & Sime to undertake works to speculative office accommodation months to prepare the space for occupation. The fit-out work was largely installation of new ceilings, partitions and joinery, floor finishes and special fittings such as hospitality and staff kitchens. Faram was a subcontractor engaged to supply and install partitions and joinery and was one of several subcontractors working on site over the same period.

Why, and by whom, was acceleration proposed?

Progress of preceding work was slower than planned, with the result that the start and progress of partition installation was delayed.

What was the nature of the contractor's acceleration proposal?

The subcontractor did not make a proposal: he simply introduced more staff.

What was the employer's decision-making process?

This dismayed the main contractor who was most concerned to see that the employer occupied at the planned time. No acceleration was proposed per se. Instead one of the main contractor's directors declared that if work were to finish on time that Ibex 'looks after its subcontractors'. This was taken to mean that if the pace of work was accelerated, that additional costs would be reimbursed..

What was the outcome?

The acceleration was largely successful in that work finished just one week late and the employer could occupy.

Additional Comments

The principle are of contention between the parties arose from the employe's suggestion that acceleration was within the contract price. This left the contractor in a position where he has to show (a) early delays; (b) that the earlier delays were all caused by matters for which the employer was responsible; (c) that some or all of those delays have led to critical delay of a determined period and (d) acceleration was implemented as a direct result of the delays, and pursuant to an in instructon from the project manager.

The contractor also came to appreciate difficulties with advancing the quantum section of accleration claims, particularly where different categories of cost are analytical.

S. Musgrove Park Hospital, Taunton

The project was an extension to a hospital complex. The tender submitted by the successful contractor indicated an interest in completing work ahead of the employer's planned date for completion. When the contract was let, the employer's date for completion was retained, but the contractor retained an interest in completing early.

Delays were incurred during the course of the works. The contractor sought loss and expense as a result of the additional time incurred.

A number of issues arose including the following:

- The status of the construction programme
- Whether the contractor could recovery for voluntary acceleration costs when it had always planned to complete early
- The true measure of the employer's losses in the event of the contractor finishing later than planned but before contractual completion

Some conclusions drawn:

- The parties exercised little care in completing the contract documents. There were inconsistencies between programme, and contractual requirements as set out in the appendix to the agreement;
- Although the contractor had always planned to finish early, the difference between his planned completion and contractual date for completion was referred to in different ways by different parties. The contractor referred to this as a contingency. The employer, mistakenly, referred to this as post-completion time. The lawyer, mistakenly, referred to this as float. The expression 'float' was also used by the main contractor, correctly, in referring to the free float on subcontract works.

T. Jubilee line Extension, London: Route planning: Completion in 1999

Project Description.

The project was for extension of London Underground Railway Julibee line from Green Park station, crossing the Thames to Waterloo, across to the Isle of Doges in East London and up to Stratford. Acceleration issues arose on two occasions: first at the development stage, and second at completion of the construction works

Land Acquisition stage

Why, and by whom, was acceleration proposed?

One of the most potentially difficult tasks was securing permission from landowners to build the underground beneath their property. The employer sought ways to speed up the process and reduce risk of prolonged delays tracking down and securing agreements with landowners

What was the nature of the acceleration proposal?

A Developer at Canary Wharf, which was to benefit substantially from the scheme upon completion and who was keen to see early completion, suggested that the underground route along the south bank of the Thames from Waterloo to Canada Water was moved as to site directly below the existing mainland rail network that ran through that area. As a result, there was only one landowner with whom negotiations was required. As the railway line was owned by one landowner only, the time required to negotiate consent for tunnelling was dramatically reduced

What was the outcome?

It is estimated that over 18 months was saved in land rights approval, work that was critical to the start of route definition and hence construction.

Additional Comments

This example merely shows how a change to a project's duration can be influenced by a change in design, in this case the route or removal of constraints, in this case the need to deal with more than one landowner.

Construction stage

Why, and by whom, was acceleration proposed?

Construction stage

Why, and by whom, was acceleration proposed?

Completion of the facility was required for two important reasons: first, it was the main means of transport available to reach North Greenwich, site of the Millenium Dome, which was to house an exhibition. The number of visitors to the exhibition was expected to be very high: The underground line had to be ready for the first night celebrations on 31 December 1999.
Second, under an agreement with Developer Olympia & York, London Underground had promised to forfeit a sum reported to be £500m in the event that the line was not functional by 1 January 2000. The line was required, complete with a new underground station at Canary Wharf, to serve the new office and commercial facilities at Canary Wharf.

Acceleration was suggested by various parties. In the event, London Underground engaged Bechtel, an American-based engineering and project management firm, to assist with completion of the facility. Under the agreement, Bechtel was to receive a success fee if it were to succeed.

What was the nature of the acceleration proposal?

Immediate changes were made to the scope of works to be carried out and the train signalling system. Some changes were simple: all work not necessary was not to be carried out. The changes to the signalling involved dropping use of a block signalling system. Had it been used, it would have been a world prototype. In the event, the system was changed to revert to a conventional system.

In respect of some contractors who threatened to hold parts of the works 'at ransom' pending resolution of claims, it was planned to convert these to be reimbursable contracts.

What was the outcome?

The underground line was successfully opened on time as planned. The impact of the signalling was that the capacity of the system fell below the original plans. In additional, substantial sums were paid to contractors to effect significant changes in the work to be carried out.

Another consequence was that the non-essential works were in fact carried out in subsequent years from 2000 to 2003. This was necessarily complex as it involved working at nights in non-train or 'engineering' hours.

Conversion of some packages to be carried out on a reimbursable basis was successful in reducing contention. The conversion, necessarily, came at a high price per package but greatly facilitated achieving the overall objective.

Additional Comments

This is one of the more powerful examples of how acceleration can be introduced by changing designs, changing working methods and reconfiguring required outcomes.

U. Island House Crossing, Hong Kong

Project Description.

The project involved construction of roads and bridges for the Public Works Department of the Government of Hong Kong, a particular section of which was the Island House Level Crossing. During the course of the works delays occurred and the contractor sought an extension of time.

Why, and by whom, was acceleration proposed?

This was one of several inter-related contracts. Timely completion of this contract was very important in order to avoid delaying others also. In the absence of powers to order acceleration, a supplemental agreement was required. The engineer's origina plan was that the acceleration would be rewarded on a sliding scale basis depending solely on time saved.

What was the nature of the contractor's acceleration proposal?

The contractor and engineer prepared proposals jointly. As the engineer proposed a target-based system of renumeration, the contractor's proposal centred on changes that he sought to the proposed agreement. A significant change was that the contractor sought to recovery a base fee, with the balance on a sliding scale. In addition, a detailed submission was made showing how the bonus amount was calculated, using several methods of calculation. It is notable that a credit was allowed for savings in overheads arising from earlier completion. A large lump sum allowance was made against risk: this arose from proposed changes to conditions whereby the scope for further claims was greatly reduced.

Further, the contractor provided a short schedule of costs that he thought might be due in the event that no acceleration was instructed. This included claims already made, claims that would be made for prolongation and the value of increased costs pursuant to cost fluctuation provisions.

What was the employer's decision-making process?

The engineer proposed a target-based system of renumeration with a sliding scale. Care was taken to avoid amounts being construed as a penalty. Authorisation to accelerate was made with an understanding of the value to the project of timely completion. Before authorising acceleration the employer carried out a rapid but detailed evaluation of claims made for additional time, this aiding understanding of existing causes and noting responsibility for delays to date.

The acceleration agreement is notable for the depth to which some issues are covered.

What was the outcome?

The contractor successfully introduced the acceleration measures proposed under the agreement.

Additional Comments

The acceleration agrement covered a wide range of isssues:

- Deletion of clauses that might have entitled the contractor tofurther extensions of time and substitution with a more limited provision
- Provision of new completion dates, and new amounts for liquidated damages from those dates
- Payment of a basis acceleration sum plus a bonus
- Payment of the basis sum was to be in predetermined installments, with the bonus after completion
- Some earlier powers were extinguished
- The powers of termination and the like were retained.

XIV. Appendix B: Background aspects of Projects

A. *Project's management organisation structure*

It is not difficult to understand how a car achieves a certain rate of progress. The speed is a direct function of the amount of petrol introduced into the engine. Of course there are many other influencing factors, such as the state of the road, choice of gear, use of brakes and driving skill, but understanding how the car moves is not difficult. It accelerates by addition of more fuel to the engine. Similarly, an automated production line in a factory requires the machinery to be in working order, raw materials to be introduced at one end and power to enable the production line to work. Construction of a building, bridge, house, road, railway or process engineering plant is very different. To understand how the rate of progress on such a facility might be changed requires, first of all, an understanding of how projects progress at all. Only then can an understanding be developed as to how the rate of progress might be changed.

An understanding of the characteristics of projects, and of the defining nature of projects is crucial to understanding how project progress is, or might be, assessed, managed and achieved, and how risks external to the project might be assessed and managed in order to minimise their impact on progress.

What is a 'project'? Any attempt to understand the nature and characteristics of projects, and how projects progress and get completed, requires some preliminary analysis of what is meant or understood by the word 'project'. Thus, in the Oxford English Dictionary, the following entries appear:

> **proj+ect** *n.* **1.** a proposal, scheme, or design. **2.a.** a task requiring considerable or concerted effort, such as one by students. **b.** the subject of such a task. *~vb.* **3.** (*tr.*) to propose or plan. **4.** (*tr.*) to throw or cast forwards… [C14: from Latin *proicere* to throw down, from PRO- + iacere to throw]…

task *n.* **1.** a specific piece of work required to be done as a duty or chore. **2.** an unpleasant or difficult job or duty. **3.** any piece of work. ...

This descriptive definition of a project is only helpful in its identification that projects involve specific tasks or pieces of work to be done through effort. Today, the expression 'project' is used to represent not only doing a task, but also a task that brings about a particular or physical result. Morris (1994) refers to projects as task-oriented activities, but makes no attempt to define the term 'Project' or to differentiate projects from any other form of production. Lock (1996) notes that projects share one common characteristic: the projection of ideas and activities into new endeavours. Turner (1992) describes a project as

> "An endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work of given specification, within the constraints of cost and time, so as to achieve unitary, beneficial change, through the delivery of quantified and qualitative objectives."

Turner's definition helps to identify characteristics common to projects generally: Task orientation; finality; integration; uniqueness and exposure.

Task-orientation

Mintzberg (1979) said "every organised human activity from the making of pots to the placing of a man on the moon - gives rise to two fundamental and opposing requirements: the division of labor into various tasks to be performed and the co-ordination of those tasks to accomplish the activity". Thus, projects are progressed and completed through a collection of individual sub-tasks, more commonly referred to in project planning terminology as 'activities'. These activities are not limited to construction work, or to physical work, but include design work, procurement, and other project management tasks such as fulfilling legal procedures necessary to purchase a site or engaging consultants.

Finality

The objective of a project is to produce a given result by a given date. Examples of projects are launching a new product, relocation of office accommodation, reconfiguration of IT systems, development of a new weapons system, or construction of a bridge. A project therefore is merely the transitory state through which energy, effort and resources are directed to achieve a single result. Consequently, once the project is completed, all participants, resources and facilities that were involved in achieving the project will no longer be required. Available resources will be redeployed elsewhere. This has significant consequences, as will be described later, on the form that the organisation structure takes and on the management procedures and systems required for successful completion of the project. A project's finality differentiates it from other forms of production, such as a factory's production line where production may be continuous.

Given that a project comprises tasks or activities, all of those tasks or activities will need to be completed for a project to achieve completion. Finality dictates that each activity will need to finish by a particular date. Thus, the entire nature of progress on a project, and how that progress is managed, will be different from the continuous progress of production of a product on a production line.

Integration

Little active management input is required to maintain continuity of the production line due to the repetitive nature of the tasks to be performed. The process is monitored by establish a series of norms and testing, at regular intervals, the products being produced against the norm. The establishment of norms provides a basis against which performance can be carefully monitored. Management of the production line is thus limited, once the line has started, to detecting deviations from the norm expected and reacting to deviations. Thus, the role of the team managing the production line is limited to repairing a breakdown of the line, managing the planned maintenance programme, ensuring continuity of materials sourcing, testing quality of products being produced and ensuring backup systems are in order. Starting a line which has been established requires no planning; it will simply require a switch to be pressed. The controlling function is limited to dealing with exceptional events that influence the production line, not with running the line hour to hour.

Projects are considerably different. Mintzberg noted, as identified above, that every organised human activity gave rise to two fundamental opposing requirements: the division of labour into various tasks to be performed and the co-ordination of those tasks to accomplish the activity. Thus, co-ordination, or integration of tasks is crucial. As a wide and disparate range of independent organisations inevitably undertakes those tasks or activities, the work of those organisations requires integration. (Walker, 1996). So important is integration on projects that is considered to be one of the key tasks of the construction project manager (Bennett 1991, Morris 1994, Walker 1996).

It will not be satisfactory for tasks or activities merely to be completed. To achieve the project's completion, those tasks will inevitably need to be completed in a logical or particular order – hence Mintzberg's note that co-ordination of tasks is required. If the project is to be completed by a particular date, then logically there is also the need for those tasks to be completed by particular dates in order that later activities can commence. Integration, in the context of projects, therefore involves a high level of planning which tasks are required and planning when they are required to commence and be completed. This is very much a function of the time the tasks are expected to take and the sequence in which they are expected to take place. It follows that the rate of progress of a project is likely to be influenced by two factors: the rate at which particular activities progress, and the means, skill or method by which those tasks are integrated.

The team managing a project will frequently be, and indeed may need to be, much more familiar with management of projects than managing the client's core business. This will frequently be a consequence of the complexity of the project and the need to introduce specialists for the project to be managed. By contrast, members of the producer's organisation almost always manage the production line. Bennett (1991) and Walker (1996), adopting contingency theory, maintain that the organisation structure for each project should be designed to suit the project, according to the specific client objectives, the conditions in which the project is to be undertaken and the people available for the project. Walker observes that the development, design and construction of a construction project require a range of skills. As the project's activities will be undertaken by a wide and disparate range of organisationally independent firms, who second staff to the project on a part-time or temporary basis, probably the most important role of the project manager is that of integrator. (Mintzberg 1973, Walker 1996).

The natural consequence of the foregoing is that if a project is to be completed on time, a considerable amount of planning will be required, planning not only which tasks are required but the dates by which those tasks will require to be completed.

Uniqueness

Lock (1996) says that the identifying characteristic of a project is its novelty. Novelty, he says, is evident in that every project is unique, in that no two projects are ever exactly alike, and even a repeated project will differ in one or more commercial, administrative, or physical aspect from its predecessor. Novelty is also apparent according to Lock, as each project is "fraught with risk and uncertainty". Thus, the events and tasks leading to completion can never be foretold with absolute accuracy. Chapman and Ward (1997) observe that Turner's definition of a project, noted above, highlights the one-off, change-inducing nature of projects, the need to organise a variety of resources under significant constraints, and the central role of objectives in project definition. They remark that projects' inherent uncertainty requires attention as part of effective project management.

The project's uniqueness arises as projects involve the completion of one principal objective. That objective may be to complete building a railway line, installing an IT system or writing a book. Within that principal task there will of course be many sub-tasks or activities to undertake. Some of these sub-tasks may need to be performed repeatedly, but some will inevitably only need to be performed once.

This can be illustrated with an example. The construction of a railway line involves, on a simplistic analysis, only three activities: mobilising a team, laying tracks and demobilising the team on completion. The second task, laying tracks, is by its nature repetitive but the first and third tasks, mobilising and demobilising the team, will only be carried out once. Whilst there may within each of these sub-tasks be repetitive elements, each major stage of the project will usually only be undertaken once. Thus, on a construction project, securing planning permission, or receiving tenders, will ordinarily only be achieved once. On a project to relocate business premises, completion of legal matters in connection with acquisition of a lease will only be achieved once. This is in marked contrast to production along a repetitive production line in a factory. The project will involve one overall objective or result which will only be achieved once, and many sub-tasks, that will be undertaken a finite number of times.

One consequence of the uniqueness of a project is that, unlike the production line, there will be no measured previous performance from which future performance can be accurately predicted. In order to control a project, a plan will need to be set by estimation, based upon experience of past projects, against which project performance can be measured. It follows that the degree of confidence that one can have in the plan is lower than might be expected when planning future performance along a production line. The need for detailed planning is therefore a particular requirement in the management of projects.

Exposure to the Project's environment

The production line is usually established in a way which seeks to minimise the influences that might stall or stop production. According to General Systems Theory[410] a

---

[410] The relevance of systems theory to the management of construction projects is emphasised by Walker (1996). He describes how General Systems Theory originated in the biological sciences but its originator

system is an organised or complex whole. It is an assemblage or combination of things or parts forming a complex or unitary whole, which is greater that the simple sum of the parts. The systems approach stresses the contribution of the interrelationships of the parts of the system and the system's adaptation to its environment in achieving its objective. This is of some relevance to the work in this thesis as acceleration is a response to difficulties arising from interrelationships within the system (the project) and as a response to something outside the project, in its environment.

In recent years several authors have stressed the importance of the relationship between a project and matters outside the project system (its environment). Morris (1994) explains in some depth how the practice of project management was, until the late 1970's, focused on the use of plan and control techniques. These techniques had their foundation in the management studies undertaken by the 'scientific school' in 1920's and 1930's and were primarily developed for management of what would be regarded as closed systems. Morris notes that it was not until the late 1970's that the relationship between projects and their environments came to be fully acknowledged.

To understand how the building process operates as a system it is necessary to understand the distinction between a closed and open system. A closed system is one that does not respond to events and occurrences outside the system. It cannot adapt to changes and is therefore very predictable. The production line in the factory can be considered to be a closed system in that the parts are selected to perform specific functions in a given set of conditions to produce a predetermined output.

On the other hand, an open system adapts to events and occurrences outside the system. These events and occurrences take place in what is known as the system's environment. This has been defined as a set of elements and their relative properties which are not part of the system but a change in any of which produce a change in the state of the system (Ackoff 1971). An open system is dynamic and adapts to its environment by changing its

---

(von Bertalanffly 1969) has acknowledged its general applicability, encompassing business organisations structure and processes. Although stable, it is always changing and evolving and presents differences over time and in changing circumstances. A living organism, business organisations and the construction process are recognised as open systems.

Thus, the production line will be housed in a factory to reduce the risk of production being stopped by rain, and auxiliary power supplies will be available to ensure that production can continue even if power supplies are lost. Management time that is consumed responding to factors external to the production line is minimised as the extent of its exposure to its environment is minimised. Isolation from its external environment reduces the risk of interference to production. Without external events, once the production line is set up it will run, in theory, ad infinitum.

So far as projects are concerned, by contrast, the position is very different. Projects, by their nature, suffer a high level of exposure to the project's environment. Management systems are required in order to manage the project in that context, and so as to limit the effect on the project of changes in the project's environment. In system terms, the system's environment consists of all elements that can affect the system's state. It is difficult to understand a system, in this case a construction project, without a constant study of the forces that impinge upon it. Thus the project manager should not be concerned only with internal regulation of the system. One of the major jobs of the manager is to relate the project to its environment. He must be able to detect and analyse such changes if he is to adapt the internal organisation of the system in response to them. Project managers will deal closely with issues and problems within the project system but their actions should be orientated to their understanding of the external influences acting upon the project organisation (Walker 1996).

Walker identifies that, at its root, it is the action of forces in the environment of the client's organisation that triggers the need for construction work. The client's organisation has to respond to its environment to survive, to change or to expand, thus generating the need for construction work to be undertaken. It may be increased product demand requiring more production or storage space, or a legislative change requiring the football stadium to alter seating configurations and safety systems. Similarly, changes to the proposed building required by the client during construction will normally come about in response to environmental forces acting upon the client's organisation. Such changes may extend to a request for the project completion date to be brought forward, which would generate the need for the project to be accelerated.

As an example of other environmental forces that may influence a project's progress, Walker notes that high economic activity can produce a high level of demand on the construction industry, resulting in shortages of materials and labour; industrial action can produce labour shortages. International projects have environments that are more complex. These are factors which typically might delay a project and lead to a need to recover time.

Winch (1989) notes that environmental uncertainty arises from task uncertainty and the way in which projects are awarded. The environmental uncertainty arises, he believes, from task uncertainty due to the bespoke nature of construction, natural uncertainty such as the weather and geological uncertainty and organisational uncertainty due to temporary project conditions. He sees a separate source of uncertainty, which he terms contracting uncertainty, which is due to estimating not being an exact science and small changes in the tender success rate leading to large changes in the levels of turnover. Whilst contracting uncertainty is not part of the project environment, he observes that uncertainty in construction firm's environments and clients' environments strongly impact on projects to compound the effect of projects' own environments. Walker notes that the relative importance of the various environmental forces and their impact upon the client's organisation and the process of construction will vary between different classes of client and project. He identifies the following classes of environmental factors: political, legal, institutional, cultural and sociological, technological, economic and competitive. Importantly all of these are factors which are particular to projects and have a bearing on project performance.

Environmental forces act in two ways, either indirectly, upon the client's activities and hence transmitted to the construction process or directly, upon the construction process. The type of environment in which it exists which creates a need for high-level management skills therefore makes the construction process complex. The process must produce a clearly defined solution at the technical level of design and construction but must also remain flexible and adaptive to satisfy environmental requirements. The managing system will be required to reconcile these competing demands, which become more difficult as environmental complexity increases and in many cases may be incompatible. It is, however, clear from the work of Morris, Walker and Bennett in particular, that there is no easy or precise method of quantitively assessing environmental forces and their impact on construction projects. Indeed it would appear that this uncertainty accounts for the growth of project risk management as a separate discipline (Chapman and Ward, 1997).

As was noted above, the controlling functions within an open system need to be directed at two activities: integrating the contributors and ensuring that the project remains responsive to its environment. Lock (1996) notes that it should be obvious that if all project objectives are to be achieved, the people, communications, jobs and resources must be properly organised. He sees management of risk and uncertainty as part of project management. He notes the purpose of project management is "to foresee or predict as many of the dangers and problems as possible and to plan, organise and control activities so that the project is completed as successfully as possible in spite of all the risks." Many such risks will arise from the project's environment.

It follows from what is said above that from the nature of projects, and their potentially high exposure to their external environments, these consequences have a bearing on how the project is managed and indeed on the structure of the organisation required to manage the project. Some of these are explored in greater detail later.

B. Project's management organisation structure

Although projects have been managed since projects began, the systems, processes and tools used to manage projects have changed considerably over the last twenty-five years. Although little has been written about the how projects were managed many years ago, we know, for example that the great cathedrals in France were erected in the twelfth, thirteenth and fourteenth centuries by a master mason being engaged as Architect and that tradesmen or 'journeymen' were employed directly by the employer under the direction of the master mason. This later evolved into a system in which there was an architect and engineer employed by the Employer and a contractor engaged to do the construction work. This relatively simply model has remained right up to the present day.

Clients demands have become more complex. Today, they seek projects to be completed within short time scales and to fixed budgets. The advances in technology have resulted in specialisation within the construction industry with professionals specialising in space planning, acoustics, testing, advisory services to name but a few and specialist contractors emerging to offer piling, mechanical or electrical engineering, IT services, lift technology or supplying proprietary products. The impact of this increase in complexity has resulted in the need to consider more carefully how projects are being managed. Whereas in the middle ages management of a project simply referred to all of the work carried out by the master mason, today it has two complementary meanings, the organisation of construction work within a contracting organisation, and the overall management of the project by the employer or his representative. This section is concerned primarily with the latter.

There have been two responses to the increase in complexity within projects. The first was the development of plan and control tools to provide a more scientific method of organising work. This included the development of tools such as pert and CPM for scheduling projects. For many, project management was understood to be no more than the successful use of these tools and techniques.

It is only recently that project management has been seen as being wider than planning and control techniques to include the framework in which those techniques are applied. As Morris (1994) pointed out:

> '[Project management] is widely misperceived as a collection of planning and control techniques rather than as a rich and complex management process. Indeed many of the project management specialists themselves perhaps do not fully recognise the real scope of the discipline.'

The planning and control tools and techniques provide systems for marshalling and gathering information. This information will, however, be of little use if it is not used for the benefit of the project. The information is being generated to enable decisions to be taken. The organisational structure provides a framework within which decisions can be taken with the objective of meeting the clients objectives. The organisational structure therefore should be appropriate to the project goals if the decisions are to be taken in the clients interests.

Walker (1996) defines construction project management as:

> 'The planning, co-ordination and control of a project from conception to completion (including commissioning) on behalf of a client requiring the identification of the client's objectives in terms of utility, function, quality, time and cost *and the establishment of relationships between resources, integrating, monitoring and controlling the contributors to the project and their output,* and evaluating and selecting alternatives in pursuit if the client's satisfaction with the project outcome'.

Thus for Walker there are three key elements of construction project management: the planning and control, working through others by managing people to achieve the project, and the decision making process.

Walker is firmly of the view that there is little point in the construction industry developing its skills if they are not then implemented effectively. He says that the key to the management of construction projects is therefore the way in which the contributors are organised so that their skills are used in the right manner and at the right time for the maximum benefit of the client. Objectives and organisation must come first if the use of planning and control techniques are to be effective in providing the information on which management decisions are made.

For the purpose of achieving a construction project, an organisation can be said to be the pattern of interrelationships, authority and responsibility that is established between the contributors to achieve the construction client's objectives. Management is the dynamic input that makes the organisation work by adapting to meeting the objectives laid down for it. Management is therefore concerned with setting, monitoring and adapting as necessary the objectives of the project organisation as transmitted by the client and with making or advising on the decisions to be made in order to reach the client's objectives. This is achieved by working through the organisation set up for this purpose.

The contributors to the project act through the organisation that has been established to carry out their work, and they produce information that allows the managers of the project to make the decisions that will keep the process going. The effectiveness of the organisation structure is therefore fundamental to the quality both of the information on which decisions will be taken and of the decision making process itself. Walker's view is that an appropriately designed organisation structure for a project will provide the framework within which the other factors that influence the effectiveness of the project management process have the best chance of maximum performance in the interests of achieving the client's objectives.

C. Projects within the Economic Perspective

Superficially, it appears that projects are a process of producing a result whether a building or launching a rocket into space. Economists have studied production, defining production as the act of making goods and services. [Lipsey, R.G. Positive Economics]. Yet the neo-classical economic analysis of production, as involving Land, labour, capital and enterprise, are not satisfactory in helping to understand the defining nature of projects. A further analysis of production is, however, of assistance.

Before the late 17th and early 18th centuries, components or products were, broadly speaking, produced by hand, or with the aid of tools, individually. During the late 18th and early 19th Centuries, a period that came to be described as the industrial revolution, the means of production, particularly in the textile industry and farming, underwent changes. The introduction of mechanisation brought several changes. First, mechanisation meant that all products did not have to be built by hand. Some were produced by machine. Looms wove cloth, rolling presses allowed continuous printing, and standard tools and engineering components, were produced by machine. Second, mechanisation brought standardisation, which in turn brought economies of scale. Production within the confines of a factory reduced exposure to the weather and further increased efficiency. The 20th Century saw an increase in standardisation of components in many industries and through automated production, by which is meant today the production of components with little or no direct human intervention. An interest also developed in techniques for production management and production engineering.

Not all production, despite the industrial revolution, is carried out in factories or along a production line. Today, production processes can conveniently be divided into two categories:

1. Continuous production processes. Obvious examples are newspaper print runs, a chemical plant or any factory with a continuous production line. A continuous production system typically produces many identical components. When the product is developed, the expression used today is that it then 'goes into production' meaning that instead of developing one prototype, hundreds or thousands of cars or products will now be manufactured through the production plant.

2. Projects. This second category of production, is that which is intended to produce a single, unique, result. The process by which a single result is brought about is usually referred to, or called, a Project. Projects are a means of production. The term 'project' tends to be reserved for once-off unique products or tasks or pieces of work. Our understanding today of a project is meant to describe a particular means of production. Closer analysis suggests that, production through a 'project' appears to be the antithesis of production through a production line. Indeed, the word 'project' is also used today to differentiate the production of a particular result from production through a continuous process such as on a factory production line.

D. The Relevance of Systems Theory

The relevance of systems theory to the management of construction projects is emphasised by Walker (1996). He describes how General Systems Theory originated in the biological sciences but its originator (von Bertalanffly 1969) has acknowledged its general applicability, encompassing business organisations. The attraction of system theory as a medium for identifying a conceptual framework for the management of the construction process lies in the basic premise that a system is an organised or complex whole. It is an assemblage or combination of things or parts forming a complex or unitary whole, which is greater that the simple sum of the parts. The systems approach stresses the contribution of the interrelationships of the parts of the system and the system's adaptation to its environment in achieving its objective. This is of some relevance to the work in this thesis as acceleration is a response to difficulties arising from interrelationships within the system (the project) and as a response to something outside the project, in its environment.

To understand how the building process operates as a system it is necessary to understand the distinction between a closed and open system. A closed system is one that does not respond to events and occurrences outside the system. It cannot adapt to changes and is therefore very predictable. The production line in the factory can be considered to be a closed system in that the parts are selected to perform specific functions in a given set of conditions to produce a predetermined output.

On the other hand, an open system adapts to events and occurrences outside the system. These events and occurrences take place in what is known as the system's environment. This has been defined as a set of elements and their relative properties which are not part of the system but a change in any of which produce a change in the state of the system (Ackoff 1971). An open system is dynamic and adapts to its environment by changing its structure and processes. Although stable, it is always changing and evolving and presents differences over time and in changing circumstances. A living organism, business organisations and the construction process are recognised as open systems.

The process of designing and constructing a project on behalf of a client can be analysed as an open adaptive system. As such it needs to respond to its environment but historically it has, to a degree, protected itself from its environment by the construction of rules, procedures and conventions which have been granted validity by public authorities, professional institutions and other bodies associated with construction. Nevertheless, the environmental influences upon the process, particularly those being transmitted to it though clients, have resulted in the process becoming more responsive.

Analysis in systems terms focuses attention upon the need to bind together the differentiated yet interdependent contributors to the process. This requires a high level of integrative activity which has not traditionally been recognised and provided. The provision of integration must be directed towards the achievement of the total systems objective, which must be stated unambiguously in terms to be the client's requirements.

The determining factors of how the system is structured and operates to achieve its objectives are the technical demands of the project, together with the environment in which it is undertaken. The control function should therefore be designed to reflect these factors and be based upon the anticipated decision points in the process. The decision points will determine the interdependency of the contributors to each decision. Therefore their relationships should be designed on systems principles in terms of the contribution to each decision. Such an analysis demands that the organisational structure established for each project should be developed individually from first principles, and although a range of standard solutions may emerge, it should not be presupposed that any one solution is automatically the correct answer.

Walker (1996) suggests that the functions upon which the project management process should focus can be summarised as:

- identifying, communicating and adapting the system's objectives
- ensuring that the parts of the system are working effectively
- ensuring that appropriate connections are established between the parts
- activating the system so that the connections that have been established work effectively
- relating the total system to its environment and adapting the system as required in response to changes in its environment.

The last function noted above is of particular interest to this study. As will be noted later, the approach taken to management of projects up to the late 1970's, particularly in the construction industry, was to seek to manage the project irrespective of the project's environment (Morris 1994), thus treating the project as a closed system. As difficulties arose in the environment, whether a problem with funding, legislative change, new requirements or the need to deal with protest groups intent on halting the construction of a by-pass, the project fell into delay and costs rose. These were not treated as being the responsibility of those managing the project, so the delayed project simply endeavoured to move slowly onward. Thus, both Walker and Morris observe the need for project managers to acknowledge, and be responsive to, the project's environment. An example of action taken by a project manager in adaptation of the project's direction or objectives in response to changes in the project's environment is the implementation of acceleration.

Walker (1996) provides the example of a client who, at a late stage of the design and due to an upturn in his business, decides that the project must be expanded to include more floor space. The decision has to be appraised in terms of its effect on project cost, completion date, functional efficiency and evaluated against alternatives such as leasing extra space. This will require interaction between all the contributors to the project, and consideration of the interaction between, say, extra time required for design and construction and extra cost. The priority of competing demands would need to be resolved. A decision by a client to bring forward the project completion date, or that corrective action needs to be taken to reduce the effect of delay (both of which are achieved through implementation of acceleration) involve similar considerations. Walker notes that the project manager needs to be able to anticipate the interconnectedness generated by such decisions and to manage the system (the project) with respect to them.

The management of accelerative action will include, first, having anticipated the possibility of such action and having established a project organisation structure and systems to facilitate such a response, ascertaining the probable benefits of such action and managing implementation of acceleration. The actions required in implementation will require the same functions as noted above in respect of the project management process generally.

XV. Appendix C: Cost estimating and pricing process

Compilation of a contract sum is conventionally carried out in two stages: estimating, followed by tender adjudication. Each falls to be considered separately.

A. The estimating process.

This is the technical process of predicting costs of construction resulting in a net cost estimate. The documents available to the contractor at tender stage will typically be drawings, specifications, schedules, technical reports, programme work periods for major nominated subcontractors and possibly a pricing document such as Bills of Quantities. Within these documents the various logistical constraints, conditions of contract, phasing arrangements and possibly an overall construction period will also be described.[411]

Preparation of the estimate usually involves several activities being carried out initially: preparation of method statements and outline programme; and sending out sections of work for pricing by putative subcontractors and suppliers. Build-up of the estimate involves preparing an analysis of quotations received from subcontractors and material suppliers, preparing a build-up of all-in rates and pricing items in the bills of quantities, preparing a build-up of contract preliminaries, collating the estimate and presenting the estimate to tender adjudication. The estimate will be made up of the cost of measured work (the work shown on the drawings and/or described in the Bills of Quantities), allowances in respect of PC and provisional sums and project overheads.

Method statements

Where work is complex, or not of a type commonly carried out by the contractor, one of

[411] According to the CIOB (1997, p4), the estimate's use is not confined to the estimating and tendering of the work. It is "a base document which provides an important budget for cost control during construction and on which many assessments and judgements will be made during the construction phase".

the first stages in estimating will be to outline the sequence and method of construction of all, or parts of the work. The purpose of the pre-tender method statement is firstly to allow operational staff, perhaps those who may eventually be responsible for managing the project, to contribute ideas at the estimating stage as to how work might be carried out, and secondly to communicate those ideas to those charged with estimating and preparing pre-tender programmes.

Method statements usually focus on particular elements of work, such as excavation, where there are several different techniques for construction or where a sequence of operations is involved which may be complex and which consumes expensive plant. Thus, construction of a cofferdam for bridge or embankment construction, involving use of expensive plant, merits review of alternative construction sequences, more than painting of offices would require. Points considered when preparing the method statement are the list of operations, consideration of available resources (labour gang size, plant and supervision), approximate quantities, output rates, bay or pour sizes and reasoned alternatives. All of this may have a considerable influence on the pricing of the work. Method statements can later be useful evidence in understanding the method by which certain aspects of work originally were to be carried out.

By and large, contractors tend not to provide to volunteer to prospective employers at tender stage detailed method statements. There are good reasons for this: the methods chosen may be the only source of competitive advantage at tender stage, and contractors would not like others to have the benefit of those thoughts. In addition, discretion allows the contractor to maintain flexibility as to how the work might in fact be carried out. A possible objection to this view is that should the contractor be encouraged to change methods during the project, he will not have put the employer on notice of the method originally proposed.

Enquiries and quotations

Although in practice a very small proportion of the work may be carried out by the contractors' own employees, quotations may only be sought for specialist work or work which is not ordinarily bought by the company on a day to day basis. The objective of sending out enquiries is to ensure that technically accurate quotations are received which are compatible with the main contract conditions. (CIOB, 1997, p53) Where quotations are sought, suppliers and subcontractors will need to be advised, when quotations are sought, of programme requirements including the anticipated start date of the project, approximate start date for the subcontractor or materials delivery, the required completion date or dates, key information of significance to the progress of the works and phasing requirements. Subcontractors may need to be given an indication of the required rate of delivery and subcontractors may need to be advised of rate of progress required of them.

Contractors often differentiate between quotations which are merely sought as a 'check price', in which case quotations will usually be freshly sought after the contract is awarded, and those quotations which will be confirmed as soon as the contract is awarded. The latter exists where contract conditions are particularly onerous or technical requirements demanding and an attempt is made by the contractor to subcontract out the risk in respect of that work. It is not unusual, however, for tendering subcontractors to qualify tenders, and with insufficient time to seek clarifications, the contractor takes a gamble that upon being awarded the contract he will be able to seek more favourable tenders later from other subcontractors. The obvious conclusion to be drawn is that it should not be assumed that subcontractors would be performing their works under the same constraints as main contractors.

All-in rate and/or unit pricing

Calculation of all-in rates from first principles is the traditional method by which construction work is priced. The calculation is done in three stages. First a rate per hour is chosen for different labour groups, depending on specialism, for plant and material rates are chosen. Second, production standards are selected from the estimator's table of standards, from experience or on the basis of a subcontractor's quotation. Third, the price for the work is calculated, incorporating any subcontract or supplier price if necessary.

Thus, the price for excavation may simply comprise the cost of an excavating machine costing £16.00/hour, and a driver and banksman each at £6.00 per hour. Assuming output of the machine is $5m^3$ per hour, the cost per m^3 would be £5.60. (machine £3.20, driver at £1.20 and banksman at £1.20). Crucial as the production rate may be, CIOB suggest that there is no substitute for comprehensive company data based upon feedback from previous work of a similar nature to the project being priced.

As was seen above in respect of tender planning, the question as to how long it would take to excavate $1000m^3$, at an output of $5m^3$/hour would appear to depend solely on the number of machines and volume of labour available. One machine would take 200 hours (about 5 weeks) or three machines would complete the work within 2 weeks. It is particularly interesting to note that when work is priced in this way, it either presupposes or assumes that the resources intended to be applied will be those that produce the planned output, or suggests that the level of resources to be applied will be consistent with those implicit in the price. There is apparently, built into the price, a measure of flexibility as to how much resource will be applied at particular times.

Operational estimating

Operational estimating may be used to calculate the direct cost of carrying out work where the programme of work necessitates particular gangs of men and equipment being on site for a period of time, even though they may be working at less than normal outputs for part of this time. If, as Potter and Scions (1982, p.4) observed, enlightened contractors acknowledged that costs will be a function of groups of activities, their duration and relationships to other activities and not least of all the composite resources needed to carry out the activity, this appears to be now reflected in operational estimating as an approach. This method's use is increasing, partly because the volume of work being tendered on Bills of Quantities appears to be decreasing.

Harrison (1994, p.5) suggests that operational estimating particularly relevant where specialised equipment with high transport costs is required and where gangs with specialised experience cannot easily be utilised on other operation when not fully engaged on their own work. As Harrison observes (p.6), before a price can be calculated on an operational basis, a decision must be made as to what resources are required for what period of time, in other words a resourced programme. The processes of dealing with individual items to be priced, producing a resourced programme and operational estimating, will therefore often be iterative, with assumptions being made, tested and changed or adopted.

At least operational estimating may provide a better overview of what is required to carry out the work involved in a group of items. The attraction of operational estimating is that it tends to model, financially, the cost according to how the contractor intends to do the work, considering time and resources, rather than the somewhat crude use of norms as a basis for estimating a rate or price. The difficulty with operational estimating can arise from both planner and estimator proceeding in their tasks, one estimating the other preparing a tender programme, without reference to each other.

Build-up of preliminaries

The purpose of the contract preliminaries is to include for the pricing of items which cannot be reasonably included in the measured work. Most contract preliminaries are priced on a fixed and time related basis. Certain preliminary items relate to a once-off or fixed charge to the project, e.g. the erection of cabins and site accommodation. Other items are directly related to the contract duration, such as the utilisation and weekly hire cost of tower cranes. The selection of plant for a project will have a direct effect on preliminaries costs and ultimately on the competitiveness of the tender. The pre-tender method statement requires careful review in the light of proposed alternatives and cost exercises may need to be undertaken. The cost of installing heavy plant such as a tower crane may be considerable and will need to be considered.

B. Tender adjudication

Tendering is a separate and subsequent commercial and management function based upon the net cost estimate. (CIOB, 1997, p1) The tender will therefore comprise the net cost estimate as adjusted for commercial risk, margin and head office overheads, collectively often referred to as 'mark-up'. This involves wider considerations of prevalent pricing levels, profit level sought, and market competitive strategies. This stage may result in increases or decreases to the net cost estimate and setting out rates in the tender documents.

The final review of an estimate and its conversion to a tender is, ordinarily a function of the contractor's management team. This is usually considered to be a separate commercial function to that of the estimator in preparing the estimate. Whilst the role of the estimator is to prepare an estimate which reflects as closely as possible the likely cost of carrying out the work, the considerations in adjustment of the tender will differ.

The review process, whereby the estimate is converted to a tender, is a two-part exercise. First, it involves a review of the estimate. Traditionally it has been the function of the estimator to summarise the estimate into a form which allows easy adjustment if required. This has however always worked on the assumption that the work of producing the estimate was mechanistic, a numerical function (Ashworth, 1987, p.2). It is possible to produce an estimate in a mechanical fashion but this will represent an average job executed under average conditions and will not take into account the peculiarities of the project concerned. Introducing the judgement factor from the experienced estimator can only, as Ashworth observes, do this. Computer aided estimating failed for many years because it failed to acknowledge and allow for the estimator's skill and judgement.

Many other commentators also highlight the importance of professional judgement. Flanagan (1980) states that price prediction is not a precise scientific exercise, but an act which involves intuition and expert judgement. Ashworth (1987) notes that whenever human behaviour is involved variability must be expected and the forecasting of this relies upon an individual's judgement to project this into the future. Skitmore (1983) has stated that the dominating presence of uncertainty in the construction process militates against the production of accurate estimates by numerical analysis and synthesis alone. Beeston (1983) concludes that the development of judgement is the result of experience and those who have worked for a long time in the field are rightly proud of the ability which they have developed. This judgement is slowly and painfully built up as a result of making many mistakes and learning from them. Judgement gives a feeling of how far the data can be relied upon and how much to allow for possible error. Beeston also claims that is almost impossible to transfer this to others, without them having to go through the same long process. Proficiency in estimating was found by Ashworth and Skitmore (1982) to be a result of skill, experience, judgement, knowledge, intuition, feel, academic background, personality, enthusiasm, hunch and 'a feeling at the back of the head'. These are obviously subjective, and it is in that light that estimates should be judged.

The second stage involves making additions to the estimate for particular risks, making allowances to cover onerous or potentially difficult contract conditions, an allowance for risk otherwise (such as with respect to subcontract prices), and overheads and profit. As Fellows (1989; p.1) observes, despite the acknowledged importance of risk allocation between parties within construction contracts, "[risk] assessments are rarely quantitative - 'experience' plays the key role". He notes (p.5) that it is fundamental to the successful/optimal allocation of risks that the different natures of risk and uncertainties are appreciated and that the factors determining levels of risk are understood. Fellows noted (1996, p.8) that despite the obvious advantages of using risk management, there is little evidence yet of its application by the construction industry. What is of interest here is that if risk assessments are undertaken at tender stage to identify and quantify risk, a tenderer can either adjust his price, or seek to qualify his tender with a request for risks to be reallocated.

The third part of the estimating process (often called the tender adjudication stage) is to make an adjustment which is business strategy driven. Foremost will be the question whether the company really needs or wants the work, for if they do not a sufficiently high addition can be made to the estimate to allow other contractors to take the work on a lower price. Where the contracting company is experiencing a shortage of work, the price might be lowered to take work at a loss in order to maintain cash flow in the short term. It may involve a reduction in the overall price in order to ensure that the tender is successful, or a large addition to the price to ensure that the tender is too expensive to succeed. The extent to which such an adjustment is made will depend upon the extent of knowledge of each competitor's position or the state of the market generally. The tender adjustment usually attempts to secure work at a price which is sufficiently low to ensure the contract is secured but at a price level that does not lead to losses.

XVI. Appendix D: The elasticity of supply of Resources

This section is a study of the relative ease with which resource supply can be increased, if required. Essentially this section tests the hypothesis that an increase in supply of resources is relatively easy to achieve, working from first principles and analysis of the key characteristics of each resource group.

When used by contractors and construction professionals in UK, the term 'resources' is generally taken to refer to productive labour and supervisors, materials and the construction plant, here the wider use of the term is used. Here, 'resources' is extended to include all labour, materials, plant, supervisory assistance, managerial assistance both on site and at head office, liquid finance, energy, enthusiasm, initiative, and plans and specifications. Thus, the expression usually applies to all resources directly or indirect involved, but necessary, for production.

The commonly held view, as noted in the hypothesis above, is that acceleration involves addition of resources. This presupposes that it is possible to increase the supply of some or all resources at the appropriate time. An immediate difficulty is that different resources have different characteristics. The issue of particular concern in this study, using the language of economists, is the elasticity of supply of each resource category. For the purposes of this study, elasticity will mean the ease and/or speed with which the rate of supply of a resource can be increased or decreased in response to the need or demand to alter rates of progress. If the rate of supply of a resource is inflexible, or the capacity to supply a particular volume by a particular date is inflexible, then the prospect of increasing the rate of progress of particular activities may be very limited. If the resources were being applied on a just-in-time basis, then inflexibility may mean that no increase in the rate of progress of activities could be achieved at all.

The speed or ease with which resource levels can be changed is, therefore, of importance. An understanding of a resource's characteristics also helps understand the conditions governing elasticity of supply of a particular resource.

A. Materials

Characteristics

Materials as a resource for construction fall into either of two categories:

- Temporary materials of use during construction only. Examples include timber used as formwork, or perhaps temporary sheeting materials. Depending upon use, those materials might be reused several times. These will not be considered further here, as materials used for temporary works are usually easily available. More specialist temporary materials (such as formwork) are usually hired as plant; or

- Materials to be incorporated into the works. The volume of materials eventually incorporated into the works will be finite. The materials required will need to be delivered at the right time and comply with the relevant specification for their incorporation into the works.

Second, Mawdesley notes that materials are either storable or non-storable. The latter in practice cause little difficulty. They are either mixed on site from other storable materials or are sourced on the day intended for use. Concrete is the most common example.

Third, and this is a practical consequence of the second characteristic, is that materials to be stored before use require storage space. But storage space need not necessarily be on site. It may be that materials intended for the works can be stored at a manufacturer's premises before delivery, in a store or on another location adjacent to the site. Space as a necessary resource itself is referred to again later.

Fourth, materials need to be identifiable if they are to be incorporated into the works. This means, in particular, that components delivered to a site need to be marked or labelled, in a language that can be understood.

Fifth, materials need to be delivered, lifted into place and perhaps cut or adjusted, and fixed into position. For all materials to be incorporated into the works, therefore some other resources will be required. A minimum of two other resources will be required, labour (for installation) and information (to determine location at least) and perhaps plant. Space for installation will always be required in any event.

Sixth, and perhaps most important in the context of this study, is that materials can be delivered to a site raw or prefabricated. They can be delivered in different states of prefabrication. This can have important consequences on the way in which a project is managed. At its simplest, some materials such as concrete lintels can be formed in situ, made up on site, or delivered prefabricated. The immediate observation to be made here is that goods delivered ready fabricated will be more expensive to purchase but might be installed within minutes of delivery. Thus the volume of labour to be consumed in assembly and erection on site, and volume of plant to be consumed on site, is in large part a function of the extent of material prefabrication before delivery.

Elasticity of supply

First, the location of the project may have a crucial bearing on speed with which material delivery to site can be hastened. Projects carried out close to the location of material stockist will have little difficulty sourcing stock materials at short notice. The time taken to source and deliver materials and goods for a project in UK will be very short where the goods are held in stock by merchants and be readily available. By contrast, delivery of materials and goods to projects in remote locations may require considerable planning, and the time taken to ship goods to the project, and frequency and expense of shipping, may be significant. When the UK government undertook construction work at the Airport on the Falkland Islands, all goods and materials were sourced in UK and shipped to the site, with a shipping time of some 8 weeks. The prudent project manager may well make arrangements for materials to be delivered to a site well in advance of the due date for their incorporation into the works, to facilitate potential needs for materials earlier than expected. Alternatively where materials are delivered on a just in time basis, the prudent project manager will procure materials on a basis that allows some flexibility in delivery arrangements.

The second factor will be the nature of the materials and goods themselves. Materials traditionally used for construction projects were seen as being the most flexible resource. The attributes traditionally associated with materials were that they could be ordered at will and stored. Timber and material merchants maintained numerous branches in order to stock high quantities of goods to facilitate purchases at will. Sand or cement could be ordered and delivered within days, even hours. Bricks, timber and roof tiles could similarly be procured easily and speedily. Today, however, the timing of material supply is an important part of project planning. This changed position has come about as a result of increased prefabrication of goods before delivery to site, due to the greater propensity for specialist materials, goods and components to be specified and due to a greater propensity for goods and materials to be sourced from overseas locations.

Much specialist equipment has to be ordered, designed, manufactured, delivered and installed by specialists. The lead-time required before delivery (from ordering to delivery) can be very significant compared to the construction period. In May 1999[412] the lead-time for non-standard passenger lifts was 38 weeks. For atrium roofing the lead-time was 30 weeks and bespoke cladding systems was 42 weeks. More common features such as steel frames and raised flooring had lead times of 12 and 8 weeks respectively.

With respect to lead times for delivery of materials it is notable that:

(a) for any given product lead times can change due to technological improvements and changes in demand and supply;

(b) lead times for the same product may differ from project to project. This is particularly apparent on large projects where the demand for a particular component is significant in the whole market. Thus, when the Canary Wharf development in London was planned in 1986, it was estimated that 36 lifts were required for the main tower alone. These were ordered well in advance of other materials to secure timely delivery from manufactures. A single lift for a small building might have been secured from the same manufacturer in a shorter period;

(c) lead times differ for different materials and goods;

(d) lead time length is influenced by the extent to which the supplier has to undertake design work, or whether the goods sought are bespoke. Items with long lead times require design, preparation of working drawings, approval of drawings, materials to be procured, manufacture, agreement of finishes and mobilisation for fitting. Items with short lead items are typically built to a common standard, and stock made and ready for delivery;

(e) once items are ordered, lead times may be inflexible; and

(f) particular consideration may be required to be given to delivery as part of lead times, particularly where there are long distances between place of manufacture and installation. It is becoming more common for steelwork fabricated in England to be delivered to Japan or even Australia, or for American components to be used in European engineering projects.

Difficulties encountered from one case study tends to support the comments noted with respect to materials for incorporation into the works.

On a German Oil Refinery project a proposal was made by the turnkey contractor to accelerate mechanical works. Some equipment, including valves,

---

[412] see Building Magazine, 7 May 1999, pp 66-69

was to be supplied by the employer. The acceleration had to be abandoned when it became apparent that the rate with which valves could be supplied for the project was immutable as at the time there was no additional capacity in the European market from which more valves could be procured.[413]

Accordingly components and materials may have long lead times, require early and specific ordering for delivery at a specific date, and if delivered early the manufacturer may require storage on site under very strict conditions to avoid damage. A distinction can usefully be made between such materials and those readily available which can be stored about the site.

Where work is required to be carried out earlier than planned, and the date of material/component supply is critical, it may be that the only way to shorten lead times is to change the design and order a different component with a lower lead time. It follows that in project planning, material order dates, lead times and expected date of delivery may exert a very significant influence on project progress.

It follows from what is noted above that if acceleration proposals are being considered, a sound analysis of the proposals is unlikely to be achieved without a detailed understanding of expected material delivery dates for any materials not readily available from stockists. Where materials or goods are being supplied free-issue to an erection contractor, the employer or design team should maintain that detailed understanding.

Except in the case of traditional materials on projects in locations with ready access to suppliers, materials should not be considered a highly elastic resource. Assuming a policy of storing minimal stocks of goods and materials on site, the higher the proportion of materials which are (a) of non-standard design and (b) require design input by the supplier so that they have a long lead time, the more difficult it will be to accelerate activities involving those materials without substantial departures from the planned

[413] See Case Study for Oil Refinery, Leuna

erection sequences.

The potential to increase material supply will be highest where the main contractor is sourcing materials and where materials required are stock items available from local merchants. Potential to increase supply will be lowest where materials are bespoke, manufactured overseas, ordered through intermediaries and where the capacity to alter delivery dates is low.

Impact of material supply increases

From the sandcastle analogy it was clear that an increase in the volume of sand available would have no impact on progress on sandcastle building. This is because there is a finite volume of each particular material is required for incorporation into the works. There are two circumstances where increasing the supply of materials at the site can have a negative effect. First, the increased supply on site may reduce storage space and/or working space available.

> Steelwork was to be supplied free issue by the employer for construction of an air-cooled condenser in Norfolk.[414] In order to overcome delays the employer arranged for all outstanding materials to be delivered in ahead of schedule. In the event this caused significant delay as there was insufficient space at the site to store the material, and much of the material was not labelled in a way that allowed rapid identification. Hiring additional space and engaging additional labour to identify and sort materials delivered resolved the difficulty.

A negative effect of material increases on site arises where more prefabrication or assembly work is carried out on site than had hitherto been planned.

> On a project to erect a new paper recycling facility the construction manager arranged procurement of pipework that was to be delivered to an erection

[414] See Case Study on Kings Lynn Power Station

contractor for fabrication at the contractor's works and completed spools later brought to site for final installation. Delivery of materials was seriously delayed and instead deliveries were made in large quantities to the site for fabrication there. The effect of this was that more site-based labour was required, fabrication was more difficult and more time consuming at the site and work was undertaken less efficiently. Much work was achieved in a short period of time on site, albeit with twice the volume of labour anticipated, at considerable cost to the employer.[415]

On a CCGT Power station project in UK the engineering contractor procured Heat Recovery Steam Generators and arranged for its erection at the site by another contractor. It was anticipated that the HRSG's would be delivery to site in large pre-assembled sections. Due to earlier delays, the construction manager pressed for early delivery of HRSG's. It was later evident that the volume of site assembly required was some 50% higher than previously expected, and that overall site assembly was inefficient and slow. Overall, instead of saving time, the earlier deliveries had caused further delay to the project after considering time required for additional site assembly.[416]

The only real requirement is that the materials required for incorporation are available at the right time. Lack of the correct materials at the right time will certainly slow the rate of progress. Increasing supply will alleviate particular shortages of materials immediately required and will facilitate increased progress where other resources are available for its incorporation into the works but otherwise will have no impact on progress.

Alternatively where designs are changed necessitating different materials to those specified, considerable savings in time might be achieved where lead times are shortened and alternative erection methods or sequences can be used.

[415] See Case Study on UK Paper Mill, Kemsley

[416] See Case Study on Sutton Bridge Power Station

With respect to temporary materials, it is perhaps to be noted that a greater output might be achieved over a period of time from existing temporary materials through modest design changes. An 'efficient' design of an office block may require columns sized 500mm x 500mm on lower floors and 400mm x 400mm on upper floors. In fact a greater use of formwork may be secured, and speedier erection overall, by leaving all columns of similar dimensions throughout.

It is quite possible that a substantial increase in temporary materials, combined with a revised method of working (where the temporary materials were in fact the scarce resource) can result in dramatic increases in output over a given time.

> The start and progress of fit-out works to a central London office block was dependent upon areas being watertight, to be achieved upon completion of the external curtain walling. The curtain walling was delayed. The contractor installed a large volume of temporary sheeting panels pending delivery of cladding, thereby allowing internal fitout work to proceed. The strategy successfully allowed all work to be completed on time.[417]

B. Labour

Characteristics

Labour is commonly grouped in several ways when discussed in resource terms. Grouping may be by speciality or training. Thus, bricklayers are attributed to brick and block laying, steel erectors with steelwork, etc. Manpower as a resource has several attributes that make its deployment difficult. Some labour will often be noted as being either direct, that is directly engaged in construction work, or indirect or 'service' labour in that it is labour not directly engaged in productive work.

A key characteristic of labour is that output is variable and therefore unpredictable. Two

---

[417] See Case Study on MAFF Offices, London

key variables in determining output are the skill base and way in which labour is deployed. Differing levels of skill bring different outputs. But output depends also on matching the skill with the task to be undertaken: A top-grade plasterer could not be expected to do electrical work at the same rate as a young electrician. A bricklayer, after 10 years experience on a variety of projects, will achieve higher levels of output with little supervision than an apprentice. If either were to be allocated to carry out leadworking, glazing or welding, little output could be expected. Output will also depend upon the extent to which labour works with plant.[418] This can produce surprising results. Output achieved may increase with greater use of plant and small tools, even if the volume of labour engaged was reduced.

The other key variable in labour output will depend upon the extent to which skilled and unskilled labour works as a team. Where labour is working as a gang, the balance of specialism will similarly determine the gang's output. Where the task involves some non-skilled labouring, it should be obvious that the gang composition should reflect this. The relationship between gang mix and output can be illustrated by example. Where a gang comprises two bricklayers and one labourer, the labourer's role will typically be confined to mixing mortar and moving bricks from the store to the work area. For this example, it may be presumed that each bricklayer will lay $2m^2$ per hour, and requires the support of 50% of the time of one labourer. It will be immediately apparent that the addition of more labourers is unlikely to increase output by the gang at all in the absence of additional bricklayers. Taking the example further, if three additional bricklayers were added, without labourers, this would not result in an addition of three times $2m^2$ per hour, as such an output requires the support of labourers. Effectively, one new bricklayer would need to act as labourer to the other two, so that they can work effectively. Where further bricklayers are engaged without additional labourers, it is clear that some of the additional bricklayer's time will be consumed with labouring duties rather than productive work. Thus, where additional labour resources are added, optimal output rates will only be

[418] The supply of plant and the influence of methodology on the rate at which activities can be progressed are discussed separately below.

maintained where the composition of gangs is maintained at an optimal skill balance. The conclusion which emerges is that the addition of labour which is not trained for, or not suitable for, the task to be carried out will not automatically increase rates of productivity or increase the volume of work carried out. Thus, where activities involve different grades of labour, the ratio between volume of labour hours and total output for the team is unlikely to be direct: it will depend on the ratio of labour grades within the team.

Of wider interest, quite apart from labour's deployment and mix with other resources, is motivation. Why, it might be asked, is the labour force motivated to carry out an activity at all. The individuals involved have free will. All leading work on motivation, particularly from Maslow, McGregor and Herzberg, is related to both human motivation and in particular at how men can be induced to give *better* performance. This, it is suggested, is of little relevance here where motivation concerns providing any performance. It is suggested that motivation to provide performance is guided by a variety of factors. In order of priority, these seem to be earnings, working conditions and the working environment.

So far as earnings is concerned, both the security and level or regular earnings appear important. Primarily, performance is provided in order to earn at least enough income to cover expenditure. It is clear, however that performance is not directly related to earnings. There are at least two situations, both related to security of earnings, where an employee may provide a lower than expected rate of performance that what may be regarded as a steady average rate.

> First, where the employee believes his position is very secure, there is little incentive for him to provide anything other than minimal performance. Horner (1982. p2) noted that men are loath to work any longer or harder that it takes to achieve their own, subjective target earnings. Parkinson's law that "work expands so as to fill the time available for its completion" (Professor Parkinson: Parkinson's Law or the pursuit of progress, John Murray, 1958) is apparently consistent with this view. Conversely, where the employee perceives that poor

performance may result in less pay or dismissal and thus loss of pay, this will act as an incentive in the short or medium term to ensure that performance does not slip below the minimum level. In the long term the individual is likely to seek an alternative employer.

The second situation where performance can be expected to be lower than average is where there are concerns over whether payment will be made at all. Thus, where it is apparent that the employer may cease trading due to financial difficulties, it is extraordinarily difficult to secure sound performance from staff: many will be busy looking for other jobs.

The level of earnings influences performance in both the short and medium term. Positively, where a bonus target is set, and there is a perception that the bonus can realistically be achieved, productive labour will usually strive to achieve that target, resulting in increased productivity. That the extra earnings might act as an incentive to work is perhaps not in issue. But Horner (1982, p2) observed that although overtime increased for short periods, overtime worked consistently results in a return to, or even a reduction, in original output.

It is also reasonably clear, on the other hand, that low earnings act as a disincentive. Thus, Olomolaiye (1990, p.4) found among bricklayers that earnings related issues were the most important factor influencing bricklayers' decision to change from a particular site to another or to quit the trade altogether.

Olomolaiye found that working conditions acted as a significant influence on performance. Of similar influence was the employee's working environment. Thus, performance is poorer where there is little respect for workmates, there is an unfavourable relationship between employees and management, the work is a long way from home, or where the project is not one in which pride is not instilled (particularly where the quality of work is poor). It seems that project managers who master these potential difficulties have greater success securing labour to work on the project, and have better labour retention rates, than those who do not.[419]

It follows from what is said above that the rate of output of labour may deviate by very significant margins from project to project or even from day to day depending upon a wide variety of conditions.

Elasticity of supply

There are several different means by which the labour supply might be increased. First, new labour might be brought to site. The supply of labour is governed by monetary factors (neo-classical theory of labour economics) and non-monetary. A practical difficulty is time required for individuals to relocate and to undertake induction and training. Labour is usually considered to be a highly elastic form of resource. The conventional view is that the labour supply is always sufficient in the market when additional manpower is required. This, it should be noted, is not always the case, particularly in the following instances:

(a) where the labour must possess particular qualifications or expertise. The most obvious case in construction where this arises is with welding. Where tasks involve design, shortage of engineers skilled in the relevant work may be evident;

(b) labour tends to prefer working close to their home base. Supply of suitably qualified labour may short at the project location, particularly when it is away from a major conurbation; and

(c) there may be motivational factors which limit the volume of labour willing to work in particular areas or for particular organisations. The question of the motivation is considered below.

[419] See also McFillen, JM and Maloney WF (1988)

The second means by which the labour supplied to the project can increase is through existing labour working longer hours. This may not be easy to achieve. It requires individuals' consent, and premium time payments. A greater difficulty may that that union-based site agreements may prohibit overtime, or may place restrictions on the grade or source of labour. Statutory or local authority controls may also curtail efforts to work additional hours. There are further difficulties with working extended hours. There is, as Parkinson noted, a natural tendency to allow work fill the time available: the corollary is that working longer hours does not guarantee greater output. A related problem is that tiredness may set in toward the end of a working day reducing productivity in any event during extended hours.

The potential to increase labour supply will be highest where the prevailing regulatory framework permits overtime working, permits introduction of new labour; there is a plentiful supply of labour available to match the tasks to be undertaken; and labour identifies a readily achievable supply of motivating factors. Potential to increase supply will be limited where work is specialist and being undertaken by a subcontractor that finds little or no motivation in amending contract arrangements.

> On a project to erect an air-cooled condenser as part of a CCGT power station, the turnkey contractor agreed to provide all materials free-issue and a contractor was engaged for erection work. Delays occurred due to late delivery of free-issue materials and the contractor was encouraged to increase the labour supply on site. This proved to be difficult. The erection contractor did not have welders or fitters available. Labour from the local employment exchange was not properly qualified and individuals were not prepared to travel from a distance to the site without payment of significant premiums. A cross-site union agreement prohibited payments to individuals above stipulated rates. Weekend working was generally not permitted on the basis that the unions preferred creation of new employment rather than existing labour working longer hours. The solution eventually reached was letting some work to other subcontractors and permitting

limited weekend working.[420]

As an alternative to the foregoing it may also be possible to increase output by increasing efficiency of the existing labour supply. This is a complex area. What is reasonably clear however is that removal of other constraints to progress (such as lack of materials, lack of space to work or lack of information) or redesign of work elements, thereby providing a design that can be achieved in a shorter erection time, may provide the greatest timesavings.

> During construction of the Broadgate office complex in London the construction manager arranged for blocks and other materials to be delivered to floors and particular areas overnight or early in the morning. Toilet facilities were also provided at each floor level. The reported affect was that more time was available by skilled labour for productive work, increasing efficiency of output.[421]

Other methods for improving productivity in the short term include monetary factors (bonus) and non-monetary (motivation and leadership).

Impact of resource supply increases

Output of a particular activity ought to increase broadly in proportion to the increase in labour supply where supply of other resources is correspondingly increased and there are no other labour sensitive constraints. As will be seen later, this only applies where labour is the scarce resource. The impact of additional labour will reduce markedly where other resources are scarce. Particular loss of efficiency will occur with lack of space within which to work, lack of design information, lack of materials or plant, or lack of motivational influences.

For certain tasks, labour is exchangeable with some other resources such as

[420] See Case Study for Sutton Bridge Power Station

[421] Architect's Journal, 1988, special report.

subcontractors and plant. Substitution of labour with other resources, that is reducing levels of labour resources, may increase outputs.

Summary

The supply of labour can be increased at short notice. The cost of deployment is also readily predictable. Output from labour depends heavily on deployment of labour with appropriate skills and mixes with other resources. Without careful management, labour can be increased with a very low increase in output.

C. Plant

Characteristics

Plant has several easily identifiable characteristics. It is not incorporated into the work and, strictly speaking, it is not necessary for construction. It acts as a substitute for labour. The reasons for its use are, ultimately, economic. One would never today consider undertaking piling operations entirely by hand, nor erection of a 40 storey tower without a tower crane or goods lift, as the cost of undertaking the work using manual labour alone would be prohibitive. Plant and equipment are, essentially, labour saving devices that are designed to make tasks easier, faster and usually more economic to perform. Plant can bring dramatic improvements to output compared with use of labour alone. A backhoe digger machine can excavate $10m^3$ of soil in one hour at a cost, for the hire of the machine and driver, at 1999 rates, of £35.00, including the cost of the driver. By hand, one man would achieve no more than $0.75m^3$ in one hour. Thus, were the same $10m^3$ to be excavated in one hour by labour alone, it is estimated that 15 men would be required. The cost of the 15 men for one hour would be in the order of £200.00, approximately six times the cost of excavation by the digger. Were $1000m^3$ required, the digger will maintain its output rate, but the output of labour may deteriorate substantially due to tiredness. Accordingly, use of plant can bring two advantages: increased productivity at a lower cost per unit, and a more reliable, predictable level of output.

Convenience however comes at a price. A common characteristic of plant is that it is expensive to procure, whether in its purchase or to hire. Efficiency depends, for its cost effective operation, on high usage. Where high repetition of operations is anticipated, plant can be economically deployed. It is notable that as a resource, when plant is brought to a site, it is merely available for use. Actual use depends on the availability of an operator who can use the plant properly, adequate allocation of plant to appropriate tasks, and generally the use to which it is put. It is a potentially idle and therefore wasteful resource. The actual use to which plant might be put is variable, depending on supervisors, allocation, methods, and range of tasks available. Thus, the value of plant will depend on extent of use. There is, therefore, a significant relationship between Plant volume deployed, its value and its cost. Where proposals made to increase supply of plant arguments with respect to the expected efficiency of plant can be expected.

Plant may be subjected to operational restrictions. It may not be permitted to work in city centre sites (as can happen for example with pile drivers) or may only be permitted to work during limited hours. Plant is often physically large and must occupy substantial space. It may require power, certain foundations and certain working space in order to operate safely. These characteristics can make plant use particularly difficult. In practise, it means that the number of piling rigs introduced to a city centre site will be limited by space available. The type of crane used will be dictated or at least restricted, by space available for its use and footings needed.

Plant requires maintenance. Without regular and planned maintenance, plant is prone to breakdowns.

Plant might also be considered a relatively flexible resource. Different plant has different capabilities. Thus, different size lorries can carry differing volumes of material. Different cranes can carry different size loads. But these will in each case be restrictions on the largest volume capacity, or largest load size. The large crane or lorry is also capable of handling smaller volumes.

Plant can work in two different capacities. Plant may be working directly in the performance of activities, or acting in a supporting capacity. An example of the first is where a crane lifts precast concrete units off a lorry and hoists those units into the final position. Use of the plant in this instance is crucial to completion of the operation of installing the units. On the other hand, a crane may be employed merely in lifting material off a lorry for storage on part of the site. This is work that might be carried out at any time, so long as there is storage space available.

Elasticity of supply

Like labour, the supply of plant can be increased by (a) introducing new plant, (b) working the existing plant over longer hours and (c) putting the existing plant to better use. To this might also be added the possibility of substituting one type of plant for another.

For introduction of new or additional plant, elasticity of supply for any particular project will depend on three factors: location of the project, type of plant required and economics of plant use. So far as the location of the project is concerned, the comments made above in relation to materials apply here.

So far as plant type required is concerned, plant falls, it is suggested, into three main categories. In the first are small tools and equipment, whose supply is highly flexible. Materials such as this can be hired from stock from a plant hire group usually at only one day's notice. Even if work is being carried out at remote locations, a shortage of supply of small tools ands equipment is rarely a difficulty encountered, as contractors often oversupply the volume of small tools as the cost of holding stocks of spares is comparatively low. Included in this category are backhoe diggers for instance, which are very widely used.

In the second category are large cranes and the like. Such plant may need to be moved by suppliers from one part of the country to another to satisfy demand, and may not be readily available. As a general rule, the larger the plant item's capital value and rarity of use, the longer the lead-time for hire of equipment. Thus, a 40T mobile crane can be sourced at a few days notice across the UK. A crane with a lifting capacity of 400T, by contrast, may require one month's notice before hire.

The third category of plant might best be regarded as having an exceptionally long lead-time for supply. Batching and processing plant may be in very short supply and may require long lead times. Cranes with a capacity of, say, 1000T, may require many months notice. Some plant is not readily available for hire or only available through proprietary suppliers. Thus, lead-time will depend on the state of the market. Diaphragm walling plant may need to be ordered months in advance, where such plant is in high demand, due to the limited number of suppliers in UK. It also requires two to four weeks to establish on site. Delivery of tunnelling equipment and plant may have to await completion of another project in another part of the world, and subsequent transport to site may take weeks. Plant procured and built especially for a particular project, such the boring machines used for boring the tunnels under the English Channel, is not readily available. In that particular instance the machines were procured specially for the task and never used again. In summary, the more specialist and scarce the plant and equipment, the more difficult it will be to increase the volume of that plant available to the project.

In order for particular items of plant to be used at all, logistical problems may need to be overcome. Those problems may be insurmountable. The most common involve timing and space limitation. Thus, in order to introduce a crane to a project, time will be required not only to erect the crane but also to prepare foundations upon which the crane will stand. A mobile crane will require access and a hardstanding. It is not unusual on city centre sites for there to be no available access or severe restrictions which effectively prohibit use of cranes from the highway or from within the building. A tower crane, on the other hand, may require a piled foundation, and the project may have advanced to a stage where piles cannot be installed.

Achieving greater, or more productive, use of plant already available on site may be achieved in two ways. The most obvious is through use over longer hours per day/week by working extended hours, including working at nights or by working at weekends. It should be noted that to do so would require either available work operations, or support work capable of being undertaken. Thus, in later phases of the Broadgate office development in London in 1988, techniques were introduced to optimise the use of labour on site. Plant was used overnight to unload lorries and to position materials, such as block, bricks, plasterboard or timber as close to the area of operation for that day as possible. This reduced the time spent by working gangs in moving materials and increased spent on productive work. Plant working overnight would not, however, have been of assistance in erection of a steel frame where such erection required to be undertaken for safety reasons in daylight and steel members were being lifted from lorries directly into their final position.

The second way in which greater use can be achieved through use of available plant is through reallocation of tasks undertaken by plant so as to optimise output. This may, for example, result in increased use of plant for support operations thereby facilitating trouble free erection of a greater number of activities rather than just being dedicated to one activity.

Impact of resource supply increases

This largely depends on the activity in question. Process-led activities that are plant dependent will potential show a productivity increase proportional to plant increase in the absence of other scarce resources. The impact of plant may also be very significant where its introduction allows entirely different working methods to be used. On the other hand, plant introduced to support a multitude of activities may suffer intermittent use or underemployment. Here the correlation between increased plant cost and output will weaken. The greater problem is likely to be that increased plant supply may be uneconomic having regard to the benefit, and plant requires space which may be limited on the site.

The impact of additional plant can be illustrated from several contrasting case studies:

On a project to build a new university faculty building in Nottingham, UK the contractor realised during the project that construction sequences would need to be changed in order that a large steel walkway structure could be incorporated into the works. He suggested that construction of ventilation chimneys could be accelerated, by introduction of additional plant (in this case scaffolding) thereby providing early access for completion of the chimneys. This was done. The employer paid a premium for the additional scaffolding. In the event, this work was not critical and early completion of ventilation chimney brought little benefit to the project.[422]

On a project to build a new shopping centre in Bristol a large basement was to be built which involved early construction from ground level of a diaphragm wall. This was to be installed by one piece of proprietary excavating plan working in a complete circuit. Construction was delayed and after 50% of the wall was installed a second excavator was introduced at the construction manager's suggestion to complete the wall. In the event the diaphragm wall was installed on time. This brought no benefit to the project, as the accelerated, sections of wall installed were not critical to completion. What was critical was work dependent upon completion of earlier sections of wall and those were installed late. Acceleration of this work secured additional remuneration for one trade contractor but was of no benefit to the project as a whole.[423]

A project involving construction of an air-cooled condenser involved erection of a steel frame and later erection of pipework and ductwork. Erection of the steel frame was delayed. The contractor introduced additional mobile cranes facilitating early commencement of some critical sections of ductwork, notwithstanding incomplete steelwork. Introduction of more cranes allowed earlier delays to be largely recovered and allowed essential sections of the

[422] See Case Study on DeMontfort University

[423] See Case Study on Galleries Shopping Centre, Bristol

project to be completed on time.[424]

Summary

The supply of commonly used plant can be increased at short notice, with potentially very large impact on output when put to maximum use. As plant is used intermittently there is a risk that utilisation may not be high. For larger and specialised plant, supply periods can be long and preparation may be required at the site to accommodate its use that, pragmatically, may make impossible an increased supply.

D. Information

A vision or representation of the final form in which the materials are to be fabricated and assembled, whether descriptive or graphic, is required for a construction activity to progress. For present purposes that vision or presentation is called 'information'.

An understanding of the characteristics of information as a resource highlights why difficulties with supply of information can arise on construction projects. The contractor needs information in order to complete the work in question and typically wants as much information as possible, in as much detail as possible. For the contractor, this reduces the risk that work will be carried out incorrectly and reduces the risk of delays to ongoing work whilst queries are resolved. The contractor will also seek information well in advance of the work, so allowing time for both main contractor and subcontractors to plan the work. From the contractor's perspective, revisions increase the risk that designs or details for different areas of work may be inconsistent, that work is carried out to the wrong drawing and reduces opportunities for optimal planning.

The designer, on the other hand, will ordinarily have either an outline or detailed vision in his mind as to the final form required, but may have considerable time in which to

---

[424] See Case Study on Kings Lynn Power Station

produce drawings communicating these ideas. Where proprietary equipment or products are to be incorporated into the works or where subcontractors are undertaking some of the design work that the design team will be naturally reluctant to produce detailed design drawings without having received those details. To produce detailed drawings early runs the risk that later revisions will be required. He, not unnaturally given the time and expense required to produce drawings, may be reluctant to produce detailed drawings too early in order to avoid making later revisions to reflect subcontractor's requirements and may prefer to postpone the release of drawings for as long as possible so as to allow revisions to be incorporated before issue to the contractor. He may prefer to leave much detailed design and detailing for the contractor to determine, and leave minor details to be resolved on site. As between contractor and employer (including his design team), the supply of information causes difficulty because of these divergent interests.

Characteristics

Information might be classified by source. Information might be provided to the contractor from any one of three sources.

- The contractor may provide some or all information himself. The cabinetmaker may conceive his own design and build the cabinet entirely as he pleases. High volume speculative house builders are not dissimilar. They rely on their own resources to design and build houses and then sell the completed house without the purchaser taking any role in design or specification. But even where a contractor is working to another's design, he may also be required to provide some information himself. The designer may provide no more than schematic designs, leaving all other matters to the contractor's discretion, either by use of a performance specification, or simply by asking the contractor to 'do what is appropriate'. This is most frequently seen with mechanical and electrical installations in commercial and residential building. The designer sets out what is required, with locations of fittings, and all remaining issues such as routing of wiring and pipework, and location of supports, are left to the contractor.

- An independent or employer-led design team may provide information. It is rare for construction work to be undertaken without the input of one or more specialist designers. The employer or contractor's organisation may employ some such designers. Thus, even where the work is being carried out by a speculative housebuilder, completion may require an input from in-house designers. More usually, the employer will engage, specifically for the one project, a design team to prepare plans and specifications to communicate his intentions to the contractor. The disciplines involved will depend on the facility to be constructed but may include an architect, engineers, and perhaps a building surveyor. In preparing their designs they, in turn, will typically be reliant upon others. They will rely on their own client to approve designs and will have to change designs to accommodate clients' changing wishes. They will also be reliant upon third parties.

- Third parties can also be a source of information. Although the design team may formally be charged to provide construction information, there are several other categories of persons or organisations who either directly provide information to contractors or are indirectly involved. In the former category are specialist subcontractors who are engaged with a specific task of preparing or completing the design for particular work as well as carrying out that work. Thus, the architect and engineer may rely directly upon the expertise of a patent glazing subcontractor to carry out the detailed design and to construct the patent glazing. That design will influence detailing of structural members for instance. Those indirectly involved will include specialist suppliers. Until the designer knows which company's product is to be incorporated into the work, he will probably be unable to complete designs without the possibility that changes may be required to incorporate those products.

The other third party with a direct influence upon design and specification will be the relevant statutory or regulatory authorities. Various statutes govern or condition permission granted for construction work. In practise, in order to avoid abortive work that has to be changed after construction, design details are rarely released to contractors without securing first the required approval. Thus, design work may be undertaken, but not released to a contractor pending approval. For commercial buildings in UK, for example, detailed planning consent is required. That consent will be usually conditioned on work complying with the Building Acts and having a final form that complies with the building regulations. This means that certain sections of design will need to be approved by the local building control officer and local fire officer before construction of the relevant part. Approval may also be required from other parties such as insurers (in the case of sprinkler installations, for example), and planning officers with respect to listed building consent or work in a conservation area.

The allocation of design responsibility may have a key bearing on the speed with which design details are resolved. The time taken to resolve design details tends to rise in proportion with the number of contributors. The design of a sprinkler system, for example, requires an architect's layout drawing, an outline scheme from a services engineer, and stipulation of ceiling levels. The latter may require input from a subcontractor and/or interior designer. Resolution of details in this case is likely also to be dependent upon approval from both fire officer and insurer. Where resolution of design requires approval of third parties or authorities before implementation of the work, it should be noted that a party might have little or no control over the responsiveness of the authority concerned. Thus, it is a notable characteristic of construction information that its production is usually dependent upon the performance of third parties over which the design team may have little or no control. The need for statutory or regulatory approval, sometimes referred to as "authority engineering", may act as a significant constraint on the rate at which information is provided either by or to contractors.

Like materials, information as a resource can be stored. It could, to an extent, be produced long in advance of the date when the information is required. There are many reasons why drawings might not be completed well in advance of the work. The most significant, it is suggested, are: lack of time from appointment coupled with a client's expectation that work commences as soon as possible; existing ground conditions or the condition of an existing building may only become apparent after work commences. It may not be possible to carry out early investigations where the property is in other's control. Reliance on subcontractors or suppliers for design details makes resolution of their respective related details difficult to secure without engaging those parties specifically for the works; and difficulties resolving matters in the absence of final approval from the relevant authorities.

A characteristic feature of information is that it is difficult to specify what information is required by particular dates. This has an obvious bearing where acceleration proposals rely upon an increased rate of supply of information. The question 'what more information is required and by what dates' may be difficult to answer with certainty. The information required may be supplied later than required. The different interests of contractor and architect were noted above. The contractor typically wants information as early as possible and the architect may prefer to supply in the information as late as possible. Notwithstanding their differences, there are often differences between both as to when information is in fact required. When carrying out foundation work, the location and size of a lift pit may depend on whether the specifications of the lift installation have been finalised. It may not be apparent to the designer that one may influence the other, particularly where, for example, another party such as a structural engineer is providing foundation details.

The totality of information requirements may be difficult to predict. A certain volume of information requirements may only arise as work proceeds. The most obvious examples are with redesign due to particular ground conditions (such as existing foundations which are found and need to be avoided) and conditions arising from existing structures. Thus, where an existing floor finish of an office block is removed, leaving an uneven floor, it may be, that additional work will need to be carried out before installing a new raised flooring system, in order to comply with the flooring system supplier's requirements. Existing structures generate large volumes of queries which need to be dealt with promptly, as they arise, for work to proceed without delay.

Information can be provided with differing levels of quality. The layout drawings issued by one architect may differ in the volume of detail provided by another. One furniture drawing may show how a table is to be assembled, with details of edging, materials, and with dimensions. But equally a drawing of the same table, apparently as useful, may shown little by way of detail of joints or edges and be provided without dimensions. Worse still, it may contain conflicting or confusion data or details that need to be resolved before work can commence at all. Quality differences have two consequences. First, quality of information is difficult to define. Second, quality is difficult to test and therefore it is also difficult to measure the state of progress of supply of information.

The quality required of information is difficult to define. An unhelpful difficulty with information as a resource is that it is capable of being provided in various forms: Samples and models, drawings (sketch, outline, detailed, scaled) specifications, correspondence and spoken word. Rarely do parties to a construction contract prescribe the form in which information is required. A consequence of the difficulty with which the quality and quantity of information can be measured is that production of information is hard to plan and control.

In the absence of a common benchmark against which the content of drawings can be measured, there will always be a difficulty with measurement of drawing quality. It is, by way of example, possible for a drawing to be produced which contains details inconsistent with other drawings, and which may in due course need to be revised in order to achieve a co-ordinated detailed design. It is not unusual for drawings to be issued to contractors for tendering in full knowledge that details may later be changed. Thus, quality of information should, it is suggested, be measured by the extent to which information issued to a contractor might be used without further queries being raised and without further revision. The best information is that which, in the eyes of the contractor, can be effectively used.

Elasticity of supply

Information is a relatively inelastic resource. The procedures required for its provision may be complex. Factors influencing the rate of supply includes the skilled of those engaged in its production, volume of resources available, the approach adopted to design, the extent of undisclosed information with respect to existing ground conditions or the existing building, and the extent of reliance on third parties. Familiarity with relevant statutory and regulatory requirements is crucial. Third parties include subcontractors and suppliers who may be carrying out detailed design of certain components, details of which are required in order to complete design of related structures or components, or may include approving authorities.

A recent trend or tendency with design professionals is to engage a supplier partially on the basis that the supplier will assist with design detailing. On the face of it this outsourcing of design work ought to lead to rapid development of detailed designs of components. In practice, designs provided by suppliers are frequently the source of difficulty that arises from poor communication to the supplier or subcontractor of the interface with other components or state of the existing structure. Integration of third parties' design work can be so time consuming as to completely negate the apparent time saving benefit of third party assistance.

Impact of resource supply increases

Assuming scarcity, the impact of an increase of information will potentially be very high, allowing work to return to full productivity. Without scarcity, additional information will facilitate advance planning thereby reducing the risk of other difficulties, and can encourage development of different or better production methods, but otherwise cannot be expected to provide material productivity gains per se.

> On a project for erection of a new spectator stand at a rugby stadium the architect supplied completed details of the stadium roof to the contractor much earlier than the architect had planned. The contractor had sufficient time to design an inexpensive movable suspended gantry that allowed all roof soffit

sheeting to be installed without any support from below. This allowed roofing to proceed rapidly and allowed terrace concreting and seating to be completed concurrently. This method of construction resulted in a saving to the total construction period.

The supply of additional information may of course cause project delays were the information supplied in fact incorporates design changes that are difficult to incorporate quickly into the works. The single greatest difficulty with engaging third parties to supply information or designs is to ensure that the information supplied can be readily integrated into the other designs and can be utilised without modification.

A project to build a power station in UK was progressing well, but pipework drawings were not resolved. The turnkey contractor engaged a division of its firm based in US to complete the design, allowing the UK team to concentrate on other issues. The design supplied from US was in a different configuration to that expected and failed to accommodate the layout of certain substructures already formed. The drawings had to be modified significantly, which delayed the start and progress of pipework.[425]

A central London office refurbishment project was delayed by discovery of an unexpected configuration of the existing structure. In an effort to rapidly supply a design solution to the contractor the architect sought the advice of a brickwork support supplier. The solution provided by the supplier was accepted at first, and later realised that further consequential design changes would be required. The designs were later substantially modified in order that they could be utilised on the existing structure. The brickwork was completed much later than planned. In the event none of the earlier delays were reduced and the project delays

[425] Case study for Sutton Bridge Power Station

increased.[426]

Summary

Information is a relatively inelastic resource. Whilst some design work may be simple in nature, or appear simple, much involves drawing together information from a variety of sources, including contractors and suppliers. Information may also need to pass a complex approvals system before usage. The benefits of a greater supply of information can however enable significant output growth. This suggests that increasing the supply of information, which may be difficult but of low cost, should be a key area of focus of any party contemplating acceleration.

E. Subcontractors as a resource

Although not traditionally regarded as a resource, use of subcontractors has largely replaced employment of direct labour by many of the larger construction firms in UK today (Ndekugri, 1988, p2). The level of subcontracting, as Ndekugri notes, can be as high as 80-90% of the work to be carried out. Management of subcontractors has become a very significant part of the main contractors work: many now undertake work on bases such as construction management or management contracting which result in the main contractor arranging for all work to be done by subcontractors, or works contractors. One consequence of increased use of subcontractors has been the development of management expertise in planning and controlling work.

Characteristics

For the purposes of this study, 'subcontractor' will be taken to mean arrangements whereby another party provides to the main contractor a service (incorporating labour and materials and possibly plant) to facilitate completion of activities, on a lump sum

[426] Case study for Great Pulteney Street, London

arrangement. Today the subcontractor's involvement may include design, securing regulatory approval, manufacture, supply and installation. The trend in recent years has been for designers to leave much detailed design work to subcontractors (Davis, 1984, p2).

Subcontractors fall into several categories. The most straightforward are those for purchase of resources. Thus, strictly speaking a purchase order for materials is a subcontract. So also is a plant purchase order. Contracts for the hire of plant, including scaffolding, or labour or site services such as cleaning, where provided on the basis of a time charge per unit, are not considered further.

Mawdesley et al (1997, p.61) notes that use of subcontractors is widespread. He records benefits claimed for their use as including: they enable main contractors to carry out specialised tasks without maintaining a skill base; they reduce the fluctuations in levels of direct labour employed by main contractors; and they provide a degree of certainty with respect to cost and time. That certainty is apparently provided through obligations under subcontracts for the subcontract work to be completed by the subcontract completion date and to the subcontract price. Thus, growth with the use of subcontractors should not be surprising. Contractors were relieved of the responsibility for training employees in trades and running apprenticeship programmes, and were relieved of the difficult of managing a direct labour force.

Subcontractors have not traditionally, but now ought to be, regarded as an independent resource as their attributes differ from the attributes of labour, materials and plant under the control of the main contractor.

The subcontract provides apparent certainty of the cost and time of performance. The subcontractor which contracts to do work sees that the work is done to (a) earn a profit if possible and (b) save itself from being sued for failure to undertake the work properly, timeously or at all. Thus, the price paid by a contractor to a subcontractor for certain work is the price paid to secure the performance of that work. The subcontractor takes the risk on the price and may have to forfeit damages in the event he does not complete work on time. This, it is perceived, is at least a motivation toward timely performance.

There are also disadvantages to use of subcontractors. To secure a good price, it is best to leave it to the subcontractor to decide how it is he wishes to carry out the work. In doing so, all that might be stipulated is a start and finish date for the subcontract works, whereas the reality on reflection may be that certain interim stages are crucial to progress of other works. Were the contractor to insist on certain areas of work being carried out in a particular sequence or by certain dates, such instructions may significantly affect the subcontractor's economics and prove expensive. Accordingly a disadvantage to use of subcontractors is loss of day-to-day control. On the other hand, where the contractor stipulates in detail particular dates for particular sections, he will inevitably have to pay more where those dates cannot be achieved. The less obvious attribute of the subcontractor, which is a function of the loss of control, is that despite the best efforts of all interested parties and despite the financial penalties implicit in failure to complete the work on time or at all, the subcontractor may cease trading in which case an alternative subcontractor or team will be required to complete the work. Securing replacement or additional subcontractors at short notice will be more difficult where the work includes design and fabrication of components.

The other attribute of subcontract work is that it will need to be co-ordinated and integrated in with other subcontractors or in with the contractor's direct labour. This integration can be particularly difficult. Supervision needs to oversee the work, ensure smooth integration and ensure that the work is not held up for want of other resources. Attendance may also be required on subcontractors, particularly in provision of plant, scaffold, and power. The failure to provide the direction or attendances will inevitably affect the subcontractor's performance.

Although rarely recognised, it seems, an attribute of subcontractors of some importance is that subcontractors, like direct labour, require some motivation. The motivation is, it seems, and unlike labour, largely provided through economics. The immediate incentive to performance is the subcontract price. Subcontractors trade to make a profit in order to provide a satisfactory return on the owner's investment. Once work begins under the contract, the potential liability for failure to complete the work at all, in the form of damages, or for late completion, through damages, usually acts as a sufficient incentive to continue and complete the work.

There are circumstances where subcontractors may offer better than expected performance or may offer to improve performance during the project at no extra price. This notably has arisen on prestigious projects where the subcontractor's association with the project is seen to be good for external relations and publicity,[427] or where the subcontractor has an interest in maintaining an ongoing relationship with the main contractor to secure future work.[428] Both cases are economic in nature, in view of the potential for profitable work in the future. Apart from that, it seems that the only incentive to subcontractors to perform at a rate faster than planned is through payment of additional sums that (a) enable the subcontractor to recover the additional costs incurred and recover losses and/or (b) provides the opportunity to increase profit.

Elasticity of supply

An increase in the progress of subcontract work may be achieved either through existing subcontracts or by employment of new subcontractors. Each alternative is difficult.

So far as existing subcontracts are concerned, it was noted above that a significant difficult in commissioning work through subcontracts is the potential loss of control. If the subcontractor's obligation is merely to commence work by a particular date, he will also have the freedom to carry out work as he wishes, so long as he completes by that date. The main contractor, ordinarily, will have no control over the resource levels deployed by the subcontractor at any time. Any attempt to do so could only proceed on

[427] There was reportedly keen competition to act as subcontractors for the repair and rebuilding work at at Windsor Castle after its fire

[428] The larger supermarket chains in UK have long relied upon this loyalty and the promise of future work

the basis of agreement between the parties, and from the perspective of the subcontractor would require either reimbursement of additional costs incurred or payment of a lump sum price. There are, therefore, three significant difficulties with attempts to accelerate through existing subcontractors. First, in negotiating an agreement, the subcontractor may well be in a monopolistic position. Agreement may only be reached by payment of a premium. Second, those negotiations may have to proceed within a very limited period of time. Third, such negotiations may not be successful.

The second means of increasing progress of subcontract work is by use of new, additional, subcontractors. For several reasons, this may prove difficult, impractical, and uneconomical. First, the most insurmountable problem may be the period of time taken to engage a new subcontractor. Factors which will extend lead times, from enquiry to performance on site, will be availability of specialist resources, the extent of design or detailing work to be undertaken, extent of involvement of third parties such as suppliers and approving authorities in the design process, lead times for materials and goods being procured by the subcontractor and time taken to manufacture the goods in question. The second difficulty is that shortage of time may mean that new subcontractors may have to be engaged at a premium.

The third difficulty is that it may not be possible, or may be impractical to omit work that an existing subcontractor was due to carry out and ask another to do it. Where an order has been placed for manufacture of lifts, and the manufacturer has already started their manufacture, it will rarely be practical to engage a new manufacturer. Where a pipework contractor for a process engineering plant has designed all pipework layouts and has placed orders to purchase the materials, it will rarely be practical to engage another subcontractor. If, in either of these cases a new manufacturer or subcontractor was to be engaged, not only would the lead time difficulty have to be overcome but compensation for loss of profit and wasted expenditure would be payable to the existing manufacturer. The likely cost of compensation may make such a course of action uneconomic.

---

to keep construction costs low.

Impact of resource supply increases

The impact is potentially high. Difficulties are likely to include lead times both in understanding work to be done and in design or fabrication work, and securing space and areas of work.

> An electrical subcontractor was engaged to carry out electrical work to two separate buildings as part of construction of a new kiln at a cement mills. Work to one building was not critical. The subcontractor's progress on the critical section was perceived to be poor largely because of he had limited resources and had given priority to the non-critical section of work. In order to recover project delays the remaining electrical work in non-critical section of the subcontractor's work was omitted and was completed by a new, additional subcontractor. This proved to be beneficial in that it allowed limited resources to be concentrated on the critical work, and meant that no further delays were incurred due to slow electrical work.[429]

> An additional mechanical subcontractor was introduced to aid progress of delayed work at a CCGT power station. This caused considerable difficulties due to introduction to the site of non-union labour and poor integration of the new subcontractor with other contractors on the site. In the event, although the performance of the new contractor was satisfactory, other contractors complained that their progress was delayed by having less space to work on site. None of the project delays were recovered.[430]

Summary

The use of additional subcontract resources is difficult. There are difficulties with securing assistance, but more usually with managing and controlling work to be done and

---

[429] Case Study for New Cement Mills, Rugby

[430] Case study for Sutton Bridge and also, co-incidentally, Barking Reach Power Station Condenser works.

their co-ordination with others. Pragmatically, assistance from additional subcontractors is most likely to achieve greatest output where a new contractor is introduced to carry out isolated work. Otherwise, requesting an incumbent subcontractor to increase output is likely to be costly with little prospect of success.

F. Space as a resource

Space as a resource is generally taken for granted. Like many things taken for granted, it is only the absence of space at a particular time which highlights its necessity as a resource for construction.

With the recent exception of Mawdesley et al (1997, p64), it seems that space has never been considered a resource in planning construction work. Mawdesley et al suggests, validly it seems, that space may be crucial to planning. In detail, they observe that in detailed construction planning it is wise to allocate space as a resource to activities where is it is clear that, in certain areas, there is a limit to the number of activities that might proceed concurrently. The difficulty, it seems, is that it is usually presumed that there will be sufficient space for all work to proceed. Conversely, it is notable how frequently, in claims for disruption, contractors refer to lack of space, or 'congested working' where much labour attempts to work in one area, as having reduced productivity. Thus, it seems appropriate that space should be considered an essential resource.

There are, it seems, good reasons why space is rarely considered formally in construction planning. First, it cannot easily be modelled within modern planning software. Preparation of histograms showing space available or to be consumed at particular times is rare. It is, after all, common for construction programmes to be prepared in bar chart form without any formal reference to any resources, let alone space. The second problem is how availability of space might be calculated. The difficulty is not space per se, but that a minimum volume of space is available for work to proceed. Mathematically this should present little difficulty. In respect of any given defined area, a resource limit might be specified. But this is not without difficulty. Resources such as scaffolding may occupy space. Much more difficult is that planning software is designed to deal with logic constraints when resources are limited. In fact, space to work may not, strictly speaking, be limited. It may simply be that efficiency is reduced when there are too many resources in the one area. Such apparently complex calculations are difficult to accommodate within anything but the most complex and expensive project planning software.

Characteristics

Space required, when considered in detail, appears to fall into two categories. The first is the physical space required for an item to be erected. Either the space is already consumed, being used to store temporary materials, or it is not yet available. One cannot tile a wall if the wall is not yet finished. Tunnel lining can only be installed in the cut section of a tunnel and is dependant upon the rate of progress of the tunnel head.

The second category is working space, for erection, and for pre-erection and storage. This can provide more serious difficulties, particularly on city centre construction sites, where the footprint of the completed facility may be the only space required. But an advantage of 'working space' is that where goods, materials or components might be assembled off-site, it may be possible to increase easily the volume of off-site space.

Elasticity of supply

If the rate of progress of work was to be accelerated, it follows that resources working in any particular area may increase or that the requirements for working and storage space may increase. It follows that steps should be taken to avoid reaching space limits. How might this be achieved? Is space inflexible?

Available space in which to work can be increased by working overtime and at weekends. What happens, in effect is that spare space available overnight and at weekends which otherwise would not be consumed, can be consumed. Thus, working longer hours without increasing labour levels is a particularly appropriate response where space is limited.

A more complex solution is to arrange for some elements of work to be prefabricated off-site. It will be obvious that the space limitation is on-site, not elsewhere. In practise this may be difficult to achieve in the short term. If more work is required to be done in a short period of time, the prefabrication of components off-site with delivery in a 'ready to install' state will increase work carried out without reducing available site space.

Third, one benefit of accelerating non-critical activities is that their completion may allow subsequent work to proceed earlier than planned, or may provide free space (that is space vacated by labour) until the succeeding activity commences. Fourth, serious consideration should be given to leasing neighbouring sites for short periods to accommodate material deliveries and space for prefabrication. This allows increased stocks of materials to be held on site and avoids potential for late delivery of materials and goods.

Impact of resource supply increases

Increased working space on site in which to carry out activities is likely to have two effects: it removes a constraint on labour achieving optimum output levels where work otherwise would have been carried out in congested conditions and it allows successive activities to progress in the area available. The effect on output can be considerable. This can also help to reduce the risk of delay caused by poor co-ordination of subcontractors.

> The start and progress of fit-out works to a central London office block was dependent upon areas being watertight, to be achieved upon completion of the external curtain walling. The curtain walling was delayed. The contractor installed a large volume of temporary sheeting panels pending delivery of cladding, thereby providing entire floors to proceed in watertight conditions, allowing internal fitout work to proceed. The strategy successfully allowed all

work to be completed on time.[431]

Securing additional storage space close to the site can also prove beneficial in several respects. Additional space for material storage can provide space for pre-fabrication of components and should reduce the risk of delays due to lack of materials or difficulties identifying materials. Otherwise, increasing space is unlikely to be of any material benefit to the project.

> Steelwork was to be supplied free issue by the employer for construction of an air-cooled condenser in Norfolk. In order to overcome delays the employer arranged for all outstanding materials to be delivered in ahead of schedule. In the event this caused significant delay as there was insufficient space at the site to store the material, and much of the material was not labelled in a way that allowed rapid identification. Hiring additional space and engaging additional labour to identify and sort materials delivered resolved the difficulty.[432]

[431] Case study for MAFF Offices, London

[432] Case Study for King's Lynn Power Station.

XVII. Appendix E: The Construction Planning Process

A. Planning as part of the construction process.

Planning generically includes business planning and strategy development, estimating, financial planning, budget setting and setting of standards, resource, method and sequence planning and programming. The expression "planning" within the UK construction industry is often misunderstood or misused as referring alone to programming. Erskine-Murray (1972, p.3) noted in 1972 that programming was frequently over-emphasised in the context of construction planning, and young planners believed that planning was programming. It is suggested that the same misconception is common today. As will be clear from what follows, preparation of construction programmes involves both planning phases and detailed programming, or 'scheduling'[433] of activities.

Ritz (1994, p87-90) distinguished both planning and scheduling. He took the view that the terms 'planning' and 'scheduling' mistakenly were thought to be interchangeable but ought to be used separately. He noted that the project or construction managers and their key staff prepare the master plan, whereas the scheduling staff put the plan on the time schedule. He sets out three definitions of planning as "a bridge between the experience of the past and the proposed action that produces a favourable result in the future", "a precaution by which we can reduce undesirable effects or unexpected happenings and thereby eliminate confusion, waste and loss of efficiency" and "the prior determining and specifying of the factors, forces, efforts and relationships necessary to reach the desired goals." The latter emphasises the need for an organisational phase before executing the plan. Ritz (p.117) proceeds to distinguish three types of planning:

1. Strategic planning, which involves the high level selection of the project

[433] The terms 'programming' and 'scheduling' are interchangeable. The former tends to be used in European and commonwealth countries, and the latter originates, it seems, from North America.

objectives. This is undertaken by corporate planners, or by the project development team, in deciding what project to build, what the completion date has to be to meet business objectives. This may require the input of market analysis, financial planning, project feasibility and so on. It is often at this stage that the employer sets the project completion date.

2. Operational planning, which involves the detailed planning required to meet the strategic objectives. This largely comprises what Ritz calls the master plan or contracting plan, sometimes referred to as a project execution plan. This would be prepared by the construction management team and would address a time plan, budgets and resource planning.

3. Scheduling, which puts the detailed operational plan on a time scale set by the strategic objectives. The resulting schedule, prepared by the contractor directly responsible for the work, is the working document used to set the major milestones and monitor construction progress.

Ritz's differentiation of planning is probably more relevant to employers and project managers acting on their behalf or contractors undertaking a full development including design. The planning and scheduling work carried out by contractors carrying out work on a lump sum basis probably only falls into the second category (in part) and the third categories. For convenience, the planning process will be reviewed in the two distinct stages found by contractors:

- Pre-tender planning, which comprises the planning considerations during the preparation of an estimate and its conversion into a commercial bid.

- Contract planning, which is planning work undertaken after award of the contract before work starts. This is planning which is required to be implemented in order to maintain control and ensure that the project is completed on time and within the cost limits established at the tender stage.

Why do contractors carry out planning as part of the construction process? The traditional view was that project management, and construction management, was no more than a collection of plan and control techniques. Erskine-Murray (1972, p.3) suggested in 1972 that in planning for construction, the making of decisions on how to carry out each operation is paramount. More recently Cooke and Williams (p.73) suggested that planning is to aid contract control, to establish realistic standards, to monitor performance in terms of output, time and money and to keep the plan under constant review to allow corrective action to be taken. Ritz (1994, p.107) considers sound planning to be the cornerstone of effective construction management and believes that planning the broad range of activities involved with any type of capital project is essential if project goals are to be met.

In recent years, some commentators have observed that the role of management in construction has less 'plan and control' focused, and more concerned with the management of risks. Bennett noted that the purpose of management in construction is to reduce uncertainty. This, it is suggested, reflects the more modern approach which sees risk management as part of project management. Berkeley, Humpreys and Thomas (1991) concluded that much could be gained if project managers could be educated to manage their projects effectively though an appreciation of the potential effects of the interdependency of risk drivers and their own managerial actions within the projects they manage. On these views, planning is one of several tools used to manage project risk.

Regrettably the position in practice is often very different. The extent of planning commonly undertaken by contractors appears to be a function of the internal cost of planning, and its perceived value. If a contract with an employer is on a reimbursable basis, with planning work also reimbursable, the contractor will have every incentive to deploy a full range of planning services, for he will do so at not cost to him. In this context it is perhaps fair to note the increasing use of planning and scheduling as part of risk management work. This is arguably a waste, as the contractor may carry little or no risk with respect to the time for completion. On the other hand, where contractors undertake work on a lump sum basis, they bear the cost of planning. Planning is not a significant activity, although on those projects the contractor carries a greater risk. The contractor working to a lump sum price may be very concerned to set out what progress and standards are implicit within his contract price. He may be concerned to constantly monitor performance to avert deviations, which is the 'plan and control' approach.

But more often that not planning takes a limited role: setting plan for subcontractors, monitoring subcontractor's performance and reporting on progress achieved. The contractor's greatest risks are that he might, by completing the project late, be exposed to delay damages and/or be exposed to additional costs in reimbursing additional costs incurred by subcontractors. Management of those risks has traditionally focused upon their reduction, ensuring that those additional costs are recovered from the employer. The low priority afforded to planning should put employers on notice. It is quite possible, under a lump sum contract, that programmes are structured, and reports are presented, with a view to limiting those risks.

B. Preparation and Presentation of Programmes

1. Pre-tender planning

The pre-tender stage comprises a range of procedures which culminate in submission of a tender. It involves pre-selection of tenderers, the decision to tender, preparation of a site visit report, receiving the enquiry and seeking quotations, planning and temporary works, all-in rate and/or unit pricing, calculation of allowances in respect of PC and provisional sums, calculation of allowances for project overheads, completion of the estimate and internal review and adjustment and submission of the tender. Pre-tender planning is a large and integral part of the contractor's estimating and tendering process. The pre-tender stage is of interest to this study in two respects: it is during this stage that the contract price is established and the tender programme prepared. Both may influence significantly the way work is carried out.

The tender programme is an initial version of a master programme. It is prepared during the tendering period to enable main contractors to understand the important time and resource considerations of a project in terms suitable to the preparation and submission of a tender.[434] Thus, the primary reason for its preparation is usually to assist the estimating process. The traditional reasons for its preparation were:

1. As an independent check on the period likely to be required to do the work to ascertain whether the employer's target completion date is realistic or whether it might be improved.[435] Contractors are invariably provided with a stipulated period or suggested time window within which the tendered work is to be carried out. A key task of the tendering contractor is therefore to ascertain whether it will be possible for him to complete within that period and what implications compliance with the stipulated period would have upon the intended way the work might be carried out. Preparation of the tender programme may be partially to achieve competitive advantage, by exploring innovative means of undertaking work which might significantly reduce the cost of the work and hence the tender price. (CIOB, 1997, p70)

2. As a source of data for time-related matters in the tender. Thus, the planner will usually provide data upon which time-related matters will be priced, including staff, site accommodation, temporary works and general plant thereby aiding the build up of contract preliminaries and plant expenditure

3. To provide outline indications as to when subcontractors might be required to commence and complete, or when deliveries are required, for the purposes of seeking quotations from subcontractors and suppliers.

4. To identify work potentially affected by adverse weather. An understanding of timing of key activities will influence temporary works required and may cause a

[434] CIOB, 1997, p.xv

review of proposed construction methods. This may influence the tender price.

5. To ascertain by what dates key information is required from the design team. This is a sensitive area. Rarely at tender stage are contractors in possession of all project data. Some contractors publish to design teams at tender stage a schedule of dates by which key information is required in order to secure timely completion. The usual motivation for this, as a risk reduction exercise, is to put the design team on notice of dates by which information is required, in order to put in place a sound basis upon which a complaint might later be founded were late receipt of information to delay progress later.

Ordinarily, contractors do not spend much time in developing tender programmes. The effort consumed, after all, may be abortive if the tender is not successful. If he does succeed he knows that he will have ample opportunity to refine ideas and prepare a more detailed and considered programme later. Indeed, several commentators such as Harrison (1994, p.6) remark that the estimator, rather than a planner may prepare the tender programme. The aim of producing the programme is merely to test the achievability of a specified period, see if a better period is feasible and to establish roughly how and when major operations would be carried out. This is unlikely to be a detailed or considered programming or scheduling exercise unless the sequence of work or duration of the work has a significant impact on the construction cost, or where the work to be carried out is complex or unusual.

Preparation of the tender programme

Planners consistently seem to tackle tender planning in an iterative two-stage manner. First, they ascertain in outline how long it might take to do certain sections of work and prepare an outline programme, often in a crude bar chart form having regard to logic constraints; second they evaluate how the time required for each activity can be

[435] Cooke and Williams 1998, pp.75, 93

accommodated within the overall time allowed by the employer. This may be far from an optimum time in terms of cost. If the fit is poor, he will need to address what work needs to be progressed at a faster rate than might normally be expected and how this might be done. The answer may be as simple as excavating across the site starting at both ends at the same time with two excavators, or may be considerably more complex. The programme may be adjusted several times, testing different construction sequences in order to fit the time allowed.

Two methods are typically used to determine time required to execute the main sections of work:

> The primary method used involves calculation with typical output rates and standard gang sizes from previous projects. Principal quantities are abstracted from the bills of quantities or direct from the drawings for the main elements of work focusing on those items of work which, in programme terms, will be significant. The required period in man-weeks is calculated from the abstracted quantities and from expected outputs. For example, $200m^3$ of concrete work at 1.65 hrs/m^3 will take 330 hours or 7.33 man weeks. With a gang size of 4 men, the work should be completed within 2 weeks.
>
> The second method used to calculate durations is the seek advice from a specialist contractor. In practice a time in which the work is to be done is often put to the tendering specialists who may suggest, or insist upon, shorter or greater periods. The specialist undertakes an analysis of time required on a basis similar to that undertaken by the main contractor as described above.

From this, it is evident that the time allowed for particular operations (about which more is said later), if calculated in this way, is based upon two assumptions: the volume of resources to be committed, (labour and plant) per day or week; and the anticipated rate of output. An increase or decrease in the volume of resources would apparently influence the output achieved in a given period. In practice such changes in resources may be very difficult to achieve. The financial part of the estimate may be prepared on a basis which ignores planning assumptions and/or which is inconsistent with those assumptions. This potentially undermines the capacity to carry out work at the planned rate consistent with the allowances in the estimate.

It will also be immediately evident that preparation of tender programmes is rarely a matter undertaken with precision and that scant regard might be paid to seemingly inconsequential work or to details of work sequences. What the contractor may be particularly interested in however is to see what needs to be done in order to finish on time. This, in turn, may lead to preparation of schedules of information required, listing dates by which information is required and schedules of material deliveries, particularly when free issue materials are required.

Presentation of the tender programme

Traditionally contractors were not required to provide any programme before a contract was awarded. Under the JCT 1980 Edition a 'master programme' was to be provided by the contractor within one month of contract award. For employers it was at times evident that the contractor would rarely prepare the master programme in the time required and would prepare the programme following consultation with subcontractors as they were appointed. The resulting programme potentially was inconsistent with the working sequences and methods originally intended when the contract was prepared. Increasingly tendering contractors are asked by employers to submit a programme as part of the tender.[436] The request is often sourced in the employer's interest in seeing that the tendering contractor has given some thought as to how the work might be performed. The design team's interest is usually in securing what they believe is a programme that represents exactly the sequences and methods implicit in the tender.

If the contract is secured, this programme apparently represents the contractor's intentions

[436] Cooke and Williams (p.93)

with respect to the sequence and timing of particular works consistent with the contract price. This, it is suggested, is misguided. The contractor's programme, whether tender or construction programme, is only a graphical representation of the time span over which it intends to carry out particular activities or groups of activities. The contractor's plan for its work will comprise much beyond this graphical representation of planned progress. Matters which the contractor will have at some stage to consider are whether particular areas of the work are to be sublet or carried out by its own employees, which category of resource might most appropriately carry out the work, and, unless also requested in the form of a resource histogram, the distribution of labour throughout the work. None of these issues is shown on the programme.

It is perhaps worth noting that presentation of a tender programme, or a programme soon after the contract has been awarded, should not imply as a matter of course that sequences, methods or durations have been considered in any detail. The published tender programme may simply illustrate, within the contract duration, the planned start and finish dates for activities. Publication is more likely to be driven by the opportunity to make a good presentation, to establish dates by which design information is said to be required to meet the completion date or to otherwise represent graphically particular constraints. (CIOB, 1997, p75) Indeed the contractor may be inclined to publish a programme showing work commencing at the earliest possible date, particularly where he anticipates that information from the design team is unlikely to be received by the dates requested.[437] The earlier the planned dates are set, the greater the perceived delay were work to start on activities late. Thus, the published programme may differ from that which was used to assist with preparation of the tender or which may realistically be required.[438]

---

[437] This, in the Author's experience, is common. See the Case Study for the National Exhibition Centre in Birmingham, where the contractor published a schedule of information required on the day of appointment, showing that the dates for supply of some information had already passed. Starting dates for activities also differed from those on the tender programme.

[438] This was found in Case Studies for Kings Lynn Power Station, National Exhibition Centre, Offices at Wood St, and Oil Refinery at Leuna.

From this some observations can be drawn. First, the tender programme does not stand alone, but needs to be read with other documents, particularly a tender event schedule/procurement lead schedule or schedule of information required. Second, the tender programme may have been prepared with little detailed consideration. Third, it is not unusual for the tender programme and tender price to be prepared by different individuals with little communication between them. The predominant concern within the tender schedule may be even distribution and levelling over time of resources. The estimator's concern in preparation of the contract price may have been calculation of the lowest cost at which the work can be carried out commensurate with achieving a contribution to overheads and profit regardless of time-related issues. Programme details may be flexible; price is not. In this respect, the programme and price may be inconsistent. The published tender programme may of course bear little relation to the tender programme used internally be the contractor as a working document. In preparation of the subsequent construction programme that contractor may feel constrained by dates shown in the tender programme. It is notable, from case studies, that the impact of a delay can result in changes to many areas of the programme unconnected to the delay. The explanation for this, after investigation, is simply that these were changes required to the programme that the contractor had deferred pending other delays in order that the changes might not be noticed by others.[439]

2. The Contract Programme

On award of the contract the detailed planning process commences, quickly followed by operational actions such as attending meetings with other parties, placing orders with subcontractors and suppliers and mobilisation generally. Cooke and Williams suggest (p.75) reasons for planning at contract award stage generally include:

[439] In the Case Study for the Galleries Shopping Centre, after delays, the durations for finishing works were compressed. This was not noticed at the time by the employer or architect. In fact, the dates for this work were brought forward in order to disguise ongoing delays to completion. Upon later delays occurring, the full durations were restored, suggesting greater delays for the later event that was appropriate.

- to provide a broad outline plan or strategy for the project.
- to highlight key information requirements
- to comply with the contract conditions
- to establish a construction sequence
- to identify key project dates
- to enable the assessment of contract budgets and cumulative value forccasts
- to schedule key dates with respect to key material and subcontractor requirements

In order to achieve all but the first two objectives, the contractor will need to prepare a reasonably detailed programme in respect of the full contract period. Cooke and Williams (p.114) suggest that its preparation is essential in the co-ordination of the many integrated tasks to be undertaken during the project.

The construction programme is prepared to establish the operations to be carried out and when they will need to be carried out to the project to be completed on time. It is no more than a graphical representation of the dates by which construction work will be undertaken. It purports to show how the contractor has interpreted the detail of the contract documents and other information. Its principal purposes are:

- it is a purported statement as to how, at the date the programme is prepared, the contractor intends subdividing the project into sub-projects, areas of work and particular activities and as to as to when the contractor intends to start and complete those sections of work or activities;
- it is a means by which the contractor's purported intentions can be communicated to others, particularly the design team and employer, but also others such as subcontractors. Prepared properly, the programme should communicate unequivocally, providing the common reference for the timing of all activities related to the project; and
- a programme provides a basis for assessment of progress, allowing comparison between planned and actual progress achieved.

The pattern of work involved in preparation of programmes follows several stages: development of a construction strategy (an outline sequence of work and events which provides the framework for all later work), detailed planning, preparation of a draft programme, approval and presentation of the programme. After an initial appraisal below of master programmes generally, particular attention is given to two aspects of programming, the calculation of periods for items of work, and the use of programming techniques to produce the end result.

A large number of factors need to be taken into account before a workable schedule can be developed, from project objectives, resources available and cash flow, to constraints, holiday periods, productivity and output required, priorities and project constraints. A logical approach to planning is required which involves various steps or thought processes (Cooke and Williams, 1998 pp.99, 124). A comprehensive description of the process is set out by Lock (1996, p.214) as follows:

1. Defining the objectives. The technical objectives will usually be the engineered solution. It may be that much design or detailing work has to be done by the contractor; the financial objectives will have been set out in estimates or tender prices; and the time objectives will either be set out in contract documents and/or shown in outline on a simple time-scaled bar chart with the actual time-scale derived from experience of past projects.

   Cooke and Williams (1988, pp 82-93) refer to this stage as 'Collation of information', looking from the perspective of the planner rather than the project manager. This requires studying drawings and project documentation, assessing the scale and scope of the project, thinking about approximate value in relation to project time and consideration of the cash funding profile, where cash-flow may be a restraint. It also involves assessing key project constraints and dates including start and finish flags, holiday periods, key project dates such as building watertight, power on, etc.; sectional or phase completion dates and contract completion and handover dates.

2. Divide the project into manageable parts. This involves preparing work breakdown lists that define the major areas of work and those departments or organisations primarily responsible. These may be called work packages.

3. Decide in detail what has to be done and in what order. Cooke and Williams see this from the planner's perspective as the selection, identification and description of activities. This involves preparation of a list of operations/activities which must be of significance to the construction sequence and which have a duration and resource implication. Development of activity sequences requires listing operations and activities, considering the order of work and overlap between related operations and considering start-to-start and finish-to-finish relationships. This requires asking what activities must precede or follow and which may be concurrent.

   The CIOB Guide to Good Practice highlights the difficulty of selecting sufficient activities to enable a meaningful analysis to be carried out. It suggests that the number of activities used and what they represent must depend on the nature of the project, its requirements and how they will be realised in practice, and the purpose for which the programme is being prepared. A master programme will have to show sufficient detail for those managing the work. The authors advise in particular that the construction work represented by an activity should always be considered in sufficient detail to enable it to be properly related to other activities on the same programme. Activities have to be identified before any sequence may be prepared; They should be significant, unique and clearly defined.

4. Calculation of durations for each activity. This is might be undertaken directly by the main contractor or in conjunction with specialist subcontractors. This is dealt with in detail below.

5. Activity Scheduling. This involves using the activity duration estimates and sequences to calculate the estimated project duration, and the relative

significance of each activity to time-scale objectives. Lock notes that simple projects only require bar charts whereas larger projects require network analysis. It is also noted that the result at this stage may be unacceptable in that the time period exceeds the objective, requiring some rework to achieve a desirable result. Thus, stages 2 to 5 are iterative. This scheduling stage is dealt with further below.

Lock (p.128) notes, with obvious disapproval, the practice of marking down time estimates arbitrarily in order that the overall plan might shorten in duration. Such reductions should be considered, and justifiable. Whilst it is good practice to allow both flexibility and room for leeway, by working over weekend or extended hours for example, reduction of that flexibility or spare capacity is not advised.

6. Reconcile the programme with the resources that can be mustered. So far as the method used for resource reconciliation or scheduling, for small projects a bar chart can be used as a loading diagram. For larger projects and for circumstances where more than one project is making demand on common resources, the computer is used to allocate resources, taking in to account the date obtained from network analysis. The principal problem here is that the Main contractor's time allowed for certain work may be inconsistent with time required by a subcontractor.

Resource limitations, as Lock notes (p.129), can complicate planning in any situation where deadlines need to be met. The usual problems occur because the initial plan is made without reference to limited resources. Then, much later, works schedules are produced that are not possible to achieve, because the resources needed are either not there or being used on other projects in the organisation. The aims of resource scheduling are: (i) to reduce peaks and troughs in demand and supply and (ii) to provide a realistic view as to when initial and further resources are needed. This is just as important with subcontractors. This stage is considered further below, not least because some authors do not consider this stage as either significant or necessary.

7. Assign jobs to individuals by name. This, as Lock observes, is outside the responsibility of project planners. It involves personal knowledge of each individual, including degree of technical competence, speed of working, inaccuracy and special attributes.

The net result of this process is publication of a construction programme and implementation of actions to allow construction work to proceed. In the process the contractor will have had to decide how his own management team are to establish themselves and operate; how materials, temporary offices and plant are to be accommodated on the site; which work is to be subcontracted; what sequences and methods are to be adopted; what materials and resources need to be ordered; and when the main tasks are to be discharged. Significantly the construction programme does not show the outcome of these decisions. It only shows when construction work for which the contractor is responsible is to be undertaken.

Just as significant is matters not shown. The dates by which free-issue materials or information are required to be received from the design team will often be set out in a table or schedule and provided separately to the design team, independently of the programme. Dates by which materials are to be sourced, or when subcontract orders are to be placed, will of course depend on when the relevant sections of work are to be undertaken and procurement lead times prevalent in the market at the time. The main contractor may list these dates but the resulting schedule[440] is not usually provided to the employer unless the employer is responsible significantly for letting subcontracts.[441] Construction sequences may not be evident, depending on how much detail the programme contains. Where work is to be undertaken by specialists, little detail of

[440] Sometime called a Tender Event Schedule

[441] Thus, publication of a Tender Event Schedule is common on projects undertaken on a construction

sequences to be adopted may be evident from the programme, particularly where sequences are to be set by subcontractors which are not yet appointed. Lastly, it is unlikely that provision will be made in the construction programme for work to be undertaken by third parties for whom the main contractor is not responsible. This can range from planning applications, approvals, design, surveys, to installation of furniture or components or fit-out of an entire floor or area. The programme is significant as it may be the only planning-related document published to the employer but the employer should be aware it represents but one part of a larger planning and implementation process. Evaluation of acceleration proposals should necessarily, it is suggested, extend beyond a merely analysis of the programme to the wider planning landscape including arrangements with subcontractors.

Common difficulties in preparation of programmes

Theoretically the task of preparing a construction programme is a simple one, in that it merely involves developing the tender programme in more detail. It is not unusual for a construction programme to be developed from scratch (rather than updating the tender programme) after a contractor has been awarded a contract, although there is usually an attempt made to keep both broadly compatible when the tender programme has been published. The reason for this may well be due to change of personnel, or to reflect matters that developed during the tender period. In any event, it is not unusual for a tender programme to be hurriedly prepared and a more detailed consideration of activities and methods left until preparation of a detailed construction programme.

Once the contract is awarded little time may be available to let the first subcontract packages and to place orders for long-lead specialist equipment. More often than not difficulties are encountered accommodating equipment lead times and subcontractors' interests. Inevitably some packages or orders will be let later than planned. Once let, a common difficulty is that time for performance sought by subcontractors differs from

management or management contracting/prime cost or reimbursable basis.

allowances in the tender programme. Sometimes contractors chose to maintain on the construction programmes the original time allowance, (notwithstanding that different arrangements have been made with the subcontractor or supplier) in the hope of later encouraging subcontractors to work to a shorter period. A common response by main contractors is to maintain a shadow construction programme or 'target' programme to which subcontractors work, often with dates that differ significantly from those on the master construction programme provided to the employer. The target programme may be subject to frequent revision as each new subcontractor is engaged. The contract programme is unlikely to updated as regularly, largely due to the difficulty of explaining to the employer the reason for the change.

It is common, following preparation of the construction programme, to find its provisions quite different that those in the tender programme. This can be a source of some considerable embarrassment, particularly were areas of the work to be delayed due to sequence changes. The contractor may be asked then to explain inconsistencies between programmes and the impact on the cost of construction of those inconsistencies.

In summary, the construction programme is a graphic illustration as to when particular elements of work are to be carried out on site. For the project to be completed, much other planning, ordering and management will be required by which may not be evident to the employer. Design work, approvals, and work by third party contractors may be necessary but again are unlikely to feature on the programme. The programme is significant as it may be the only planning-related document published to the employer but the employer should be aware it represents but one part of a larger planning and implementation process.

Programming is not merely a technical discipline aimed at judging the time required to execute particular activities. Preparation of the construction programme involves resolving competing interests of subcontractors, supplier and employer with respect to time and the main contractor's need for work to be carried out economically.

C. *Key issues arising*

1. What duration for each Activity?

Duration is the time required for the completion of an activity. It is usual, when preparing detailed construction programmes, to estimate durations independently for each activity. Later these individual durations will be brought together to establish an overall duration for the whole construction sequence.

The CIOB (1991) published a guide to good practice with respect to preparation of construction programmes. Prepared by its members, the guide is perhaps the best reference to traditional estimating techniques in UK. Before durations are prepared and the construction sequence completed, the following information must be established by reference to the planning brief, the contract documents and the construction information available: (i) the length of the working day or week permitted or to be used; (ii) the construction method or techniques to be adopted; (iii) quantities of work covered by each activity; (iv) the unit of resource employed by the activity and (v) production rates of that resource.

CIOB recorded three means by which durations have traditionally been derived:

Quotation. Durations may be quoted in the project information or be obtained from a specialist subcontractor. These include: striking or curing time, commissioning or fitting out periods, time for approval of drawings, manufacturing or delivery periods, durations for specialist work. It may also be necessary to allocate a specialist's duration to a number of activities in the construction sequence. Before it may be used with confidence this subdivision should be agreed with the specialist concerned.

Assessment. Where assessments of durations are unavoidable these must be attempted on a systematic basis following the procedures used for a calculated duration. If this is not possible, the duration will be assessed directly using records from similar projects or judgements based on experience. Calculations or assessments and the sources of quoted durations need to be recorded for future use. Calculations should be checked against previous performance records.

Calculation. Calculation of durations relies upon use of production or output rates which are then applied to the quantities involved to derive the time required. Production rates used must be directly related to the type of resources to be employed and the construction methods to be used; both must reflect all aspects of the actual working conditions expected on the project. The quantities required for calculation may be extracted from the bill of quantities or directly from the relevant drawings. Direct measurements of this kind will usually ignore minor adjustments and labours. Periods for activities are therefore calculated given a standard level of output per manhour.

> Thus, to provide an example, given a standard output of 1.8 hours/m^2 for a 200m^2 brick wall, 360 manhours are required. The only other matter to determine, in order to calculate the duration for the work, is the size of the workforce to be allocated to this work. Bricklayers ordinarily work in teams or gangs of say 2 bricklayers and 2 labourers to assist. The labourers mix mortar, move bricks from storage to the workface, remove rubbish and assist generally whereas the bricklayers are regarded as being the productive labour. The production rate is the number of units of work achieved by one *productive* unit[442] or resource in one time unit, in this case 2 bricklayers. In this case, if it is assumed that only two men will do the work, the work should be completed within 180 hours, or just over four weeks. If 10 men are assigned to the work, in theory at least the work should be completed in 36 hours, or inside a week.

There is evident from this simple example an important observation:[443] The duration of

[442] The unit of resource is that responsible for the productive effort of the activity but will include, by implication, all items of plant, equipment and labour involved with the activity. The key or scarce resource here is labour and so the equation is expressed in terms of labour.

[443] This is also noted by Mawdesley et al (1997, pp.77-79))

an activity can in theory be almost any length of time.

Whether calculated or assessed, several other matters may need consideration in arriving at an activity's duration. Principal to consider is a proper understanding of what is covered by the activity. One may have to assume that the work described includes all temporary works operations necessary. Other planners may chose to show those temporary works separately. Even the simplest activity representing construction work may be a sequence or a sub-programme in its own right. An activity shown on a programme for 'construction of a reinforced concrete ground floor slab' may comprise a group of sub-activities including setting out and levelling, formwork and joints, installation of reinforcement, concrete and initial cure and strike. The major item of work in this instance would be the concreting operations with all other items of work associated with its performance. But the concreting itself may occupy no more than two days. Preparation in erection of formwork or later time allowed for curing may command much longer. The duration in this case would calculated by determining the elapsed number of units of time required to complete the quantity of concrete floor slab: the time required for the preparatory work, and the balance of the curing period after the last bay of concreting in finished is included in this calculation.

Regardless of the method used, Potential constraints to performance will also need to be borne in mind, in both determination of periods for particular activities and in preparing the programme as a whole:

- Design constraints - stated sequences of work in underpinning, construction joints, pre-loading requirements, humidity controls, curing times, maximum bay sizes for concrete, limited pouring heights, day joints;
- Temporary works - formwork, shoring, earthwork supports, protection of finished work, access platforms, etc;

Other issues extending to the programme as a whole include:

- Employer's requirements - key sequences, handover dates, order of works, commissioning procedures, fitting out periods;
- Construction methods - bases for cranes, work left down for access, walkways,

temporary coverings;

- Construction facilities - general scaffolding, temporary bracing, lighting and power, site offices, huts and provisions under the health and safety regulations;
- Site conditions - hoardings and fencing, security, access roads, adjoining owner's rights;
- Specialist work - the relationship of subcontractors work to the contractors own work, any attendances to be provided, builder's work in connection;
- Any provision to be made for preparation and approval of drawings e.g. temporary works and the manufacture and delivery of materials, components or equipment including those of specialists.

Various authors appear to differ in views as to the extent to which resources should be considered when calculating durations. CIOB (1981 and 1988) envisage the preparation of detailed method statements recording the planned gang sizes and for considerable thought to be given to the expected level of resources. Cooke and Williams (1998), Harris and McCaffer (1995), Oxley & Poskitt (1987) Pilcher (1992), take a similar approach. Authors, however, comment on the position of the main contractor as if all resources were their own, thus providing a somewhat misguided commentary. In fact, most, if not all, work is subcontracted. Preparation of method statements today by main contractors is virtually unheard of for construction of buildings. At the time when the master programme is awarded the main contractor may have little idea what resources subcontractors intend to deploy, largely because few subcontracts will have been let. The challenge for the main contractor is to estimate and allow durations for subcontract work in the contract programme in the hope that subcontractors can provide necessary resources to meet requirements without performing uneconomically. Some planners take the view that it is for the subcontractor to determine the necessary resource levels. The main contractor may have little effective control over the level of resources deployed or sequences of work adopted for their work. It follows that the contractor considering acceleration to a great extent will be dependent upon support from subcontractors.

Subcontractors in teams or gangs do method-related work. The basic question to be decided by subcontract estimator or project manager is the number of gangs. This does not lend to small increments in work levels. For the particular work involved, gang sizes will tend not to change. The way subcontractors chose to undertake work, and main contractor plans the work may differ.

Mawdesley et al (1997, pp.77-79)) note that in performing planning calculations it is usual to find that an activity's duration is fixed at the optimum and the resources assigned are also optimum. This will also mean that the production rate chosen to calculate the duration will be the optimum. Thus, the preparation of method statements serves no particular purpose other than to record what the planner or project manager regards as being the optimum. The authors might have added that the time allowed in the construction programme within which the activity is to be undertaken will not necessarily be the same as the calculated optimum duration. The time in the programme may be inadequate, shortened to ensure the overall project completion date is met, requiring work to be done with some additional resources. It cannot therefore be assumed that time allowed in the programme is optimum.

The resources/output relationship

Mawdesley et al (1997, p.78) note the importance of understanding the relationship between resources[444] and activities when deciding on the activities in the project plan. The plan of work should allow for conflicting resource demands. The resources which exist in construction work need to be defined and allocated to activities which can be scheduled to meet the objectives of the plan. They note that in allocation resources to activities, the following should be borne in mind:

- The number of different resources: the higher the number of resources, the more complex the model;
- The size of gangs to be used;

[444] Resources are those things required for work to progress. The term includes everything, such as

- The spread of the resources over the duration of an activity; and
- The allocation of major items of plant and equipment to more than one activity at a time.

Use of standard output rates for calculation of activity durations suggests that for any particular activity there is in principle a direct relationship between the level of resources committed and rate of progress likely to be achieved on any particular activity, and that the relationship is linear. Thus, an increase of resources, will theoretically lead to a directly corresponding decrease in the time required to carry out the work.

In practice, this is difficult to achieve. Indeed, planned outputs and gang sizes used in calculating the periods of time required for particular activities are inevitably set with view to what the activity or activities can reasonably accommodate and what would be acceptable having regard to labour relations. On a small project where the only work to be carried out was construction of the $200m^2$ wall, it may be preferable to introduce to bricklaying gangs to complete the work within 180 hours, or just over four weeks. On a larger project, where construction of the wall was merely part of the works, it may be preferable to use just one gang to do the work for several reasons. First, it would provide continuity of work for a team for over two months. Second, time spent mobilising and demobilising and developing an understanding of the work to be done would be reduced; third, it may be that the entire area in which the wall is to be built will not be available initially in which case only one gang would be able to work.

Thus, continuity of work, time spent mobilising and demobilising labour from tasks and sites, maximisation of repetition within one team and availability of areas in which to carry out work are factors to consider before introducing additional resources to any activity. These factors tend to be addressed (consciously or subconsciously) during preparation of detailed construction programmes. Importantly, they are factors that lead to differences between anticipated and actual output rates. The conclusion to be drawn is

---

information, space and finance, as well as labour, plant and materials.

that an increase in labour/unit of work will tend to increase mobilisation, demobilisation, and time lost due to the 'learning curve': reduced output in the short term due to these factors needs to be balanced against the benefit of introducing more resources. As noted by Mawdesley (p.79), and earlier in this thesis, the relationship between the size of the resource and output is not linear. The balance is frequently similar when acceleration is either proposed or needs to be addressed. What is not explicit in most written work on calculating durations is that the choice of particular outputs usually presupposes a particular resource level, and that where a change to that level or mix of resources is proposed, it must be remembered that the output rate may differ.

A difficulty can arise, particularly through use of computers to assist with preparation of construction programmes, in modelling planned performance. More is said later about computer use but it will suffice to observe here that computers were initially used in 1960s and 1970 for scheduling alone. Today, even the more basic software contain facilities to allow resource type and volume for each activity to be specified, and standard outputs to be added, thereby calculating the activity duration. The danger arises from one of benefits which computers have brought, the facility to carry out a 'what if' analysis. This operates simply by changing the resource level anticipated and recalculating the schedule to test the result. Having regard to those other factors mentioned above that affect productivity, the change in resource level might not produce the result predicted by the computer's analysis without assumptions as to outputs also being adjusted. To put it simply, the model may be deficient. Much software, in its attempt to model the scientific approach to estimating durations, ignores the impact of those practical constraints not part of the model. To the extent that the software can accommodate varying productivity, use of those features is seemingly rare. Further, the real position may be that resources can only be increased by large increments, like 100% through introduction of an additional gang.

Mawdesley et al (p.91) appear alone in commenting on care required when using computer based project models, and in identifying the need for one or more resource-duration relationships as part of the model. They also identify potential loss of output where activities might be split i.e. capable of being carried out though multiple rather than one continuous operation and note difficulties with resource-duration relationships where activities involve multiple resources. Their comments are well placed. A change to the balance of resources, as described earlier, can affect productivity as those authors suggest.

A modern approach to calculation of durations

Mawdesley et al are alone amongst writers in the approach they suggest to calculation of activity durations, an approach which appears to accommodate the use of computers for generation of programmes. They note (p.94) that as the productivity of a resource varies from day to day, in which case the output stated is merely an average, that the average is taken until more information becomes available. This average value should, if possible, come from company records (rather than other sources such as a book of norms) of similar resources performing similar work.

They note that all too frequently the lack of detailed information and the complexity (not always appreciated) of the activity models used in a plan, gives the planner an excuse to estimate activity durations based on 'experience', with no knowledge of the productivities that such durations must imply for each resource. This estimate is likely to be significantly in error and the practice should be discouraged. Even when planning the procurement activities (ordering materials for example) it is advisable to ask suppliers for information that allows monitoring of progress to be performed and control action to be taken if necessary. Planners, they note, should always bear in mind the general observation that work will take whatever time is available for its completion. It is important to set appropriate durations for activities by taking into account both experience of how long work takes and what duration for the project would be most desirable.

In conclusion, there are dangers inherent in use of programmes to model site performance; calculation of durations by use of standards assumes no resource constraints. Accordingly, globally scaling type adjustments to programmes and selective adjustment of activity durations should be reviewed with suspicion; the changes should be reviewed and attempts should be made to understand how the activities ought to be achieved within the reduced variations, rather than just treating the new durations as targets, and ascertaining whether subcontractors have already supported the proposals.

Other practical considerations relating to activity durations

Calculation of durations for activities may initially be carried out on a scientific basis, but adjusted for reasons which may have little to do with construction practice.

Where contractors are under pressure to prepare quickly a construction programme for publication, a technique employed may be to copy sections of programmes from former projects. Uprichard (1986) suggested the development of modules that could be pieced together to form tender programmes. The ease of use and low cost of project planning software in late 1990's makes this relatively easy for all types of programmes. The consequence however is that contractors may publish programmes in ignorance of, or with little consideration as to how some sections of the work are to be carried out. It no longer follows that a programme has been prepared which is consistent with either the tender method considerations or proposed construction methods or resource proposals.

The other consequence of Uprichard's suggestion results in tender planning being seen to be viewed as mechanistic. As Ashworth (1987, p2) said about estimating, views which apply equally here to tender planning, it is possible to prepare an estimate in a mechanical fashion but this will represent and average job, executed under average conditions and will not take into account the peculiarities of the project concerned: peculiarities can only be dealt with by introducing the judgement factor.

It is not unusual in preparing a master programme for a contractor to find, after a methodical analysis of key sections of work, that more time is required to do the work than is allowed within the contract period. As the use of computers has made manipulation of planning data easier, a shortening of the entire network, ignoring the possibility of rescheduling, can be achieved by making isolated reductions to the durations of key activities. Some project planning software also allows the user to state what number of days to percentage reduction is required whereupon the software will proportionally reduce the durations across the entire programme.

There are in any event several reasons why contractors may wish to issue programmes that are shorter than the time that might in fact be required. This shortening is typically least identifiable in activity durations. Where bonus payments are made against productivity, planned periods may be reduced in order that, if the target is achieved, the benefit of earlier completion might compensate for the higher cost of the work, higher because of payment of bonuses.

As was noted earlier with respect to tender programmes, it seems that when viewed as a risk management tool, sometimes the programme may be prepared in a particular way in the light of potential difficulties. Thus, if ground conditions were at the risk of the employer, and another section of work was let on a design and build basis whereby the contractor was potentially at risk with respect to that section, the contractor may decide to under-allow the duration for ground sensitive work and over-allow for period in respect of areas where he may be at risk. Thus, if ground conditions are poor, the contractor will seek to maximise the extension of time sought.

In summary it is noted that durations may be assessed, may be a reflection of a subcontractors requirement, calculated and also may be subsequently adjusted for a variety of other reasons. Durations within the tender programme may also act as a constraining influence. Programmes show durations for activities. They do not show what resources are to be used to achieve those durations or what output rates are planned. If proposals for acceleration of the project are made which involve shortening activity durations, the underlying assumptions as to resources, output and achievability will be of particular importance both in understand the planned position and the acceleration proposal.

Conclusions drawn from this section are as follows:

In the absence of constraints an activity's duration as shown on a programme will depend upon the volume of resources applied per unit of time. The actual reality is quite different, as the relationship between resources and output is not linear.

An activity's duration is also likely to be influenced (a) by the arrangements through which the work is carried out and (b) through wider project constraints.

2. Use of project scheduling techniques

A great deal has been written about, and in illustration of, project planning techniques and the planning and scheduling process. A review of the reasons for their introduction is illuminating, and of particular relevance in helping to understand the potential of modern-day scheduling. Project planning is not easy. Certain activities will need to be executed sequentially for the result to be achieved whereas others can proceed in parallel. The difficulty which planners face is to ascertain, given the durations for constituent activities, the earliest date by which the project might be completed. Several scheduling techniques developed and have become widely accepted across the developed world with much scheduling now being computerised. A review of scheduling techniques illustrates their potential use, and their limitations when preparing or evaluating acceleration proposals.

The development of project scheduling techniques was been heavily influenced by the need for a scientific approach to be introduced to planning of large capital projects and through the increased availability of low cost computer facilities (Morris, 1994). The scientific school (comprising principally Taylor, Gilbreth and Gantt) gave birth to two project planning techniques, the bar chart and critical path analysis.

<u>Bar Chart</u>

The Gantt or bar chart, developed by Henry Gantt in the USA for production scheduling at the Frankford Arsenal in 1917. The Gantt Chart, or bar chart as it is now commonly known, is a graphical representation which lists activities to be carried out down the page, and sets these activities against a horizontal timeline, showing when each activity will start and stop. It becomes immediately apparent upon inspection of a bar chart which activities are due to be in progress at any particular time, and which, for example, are due to progress concurrently.

There were three factors that led to widespread use of bar charts. First, they were simple to prepare, and could be prepared manually, at various levels of detail. They were just as easy to update. Second, they were easy to read and understand. Third, they developed, with widespread use, commonality. They became the established means of representing graphically the plan of work to be carried out and gradually became the common format used worldwide. They are still widely used today in an essentially unaltered form.

But bar charts were not without disadvantages. At the time when use of bar charts became commonplace, between the first and second world wars, it became apparent that the bar chart may have been ideal for a small project, but not ideal for the very large projects. The greatest disadvantage of the bar chart is that it is no more than its name suggests, a graphical chart. It might, or might not, have been prepared with detailed calculations and analysis. It might have been prepared without any real analysis of work sequences, it gave no clues as to the relationship between activities and gives no indication as to which activities are critical. These disadvantages lead to a further deficiency: when an activity is not progressing to plan it is not immediately obvious which other activities might be affected or what the impact on the project end date might be. In short, whereas the bar chart was an ideal means of representing the work to be undertaken, it did not readily provide a means of modelling progress, which could be tested to see the effect of delays to particular activities.

Another difficulty is that where there were a large number of activities, it was difficult to follow the chart and to track progress. On large projects, the interrelation of work activities was difficult to follow from page to page. It was very difficult to closely control the work from a large multi-page bar chart schedule. Inevitably, many activities were condensed into one line to get the complete chart on one page. Each of the tasks needed to be broken down into a series of individual tasks to control the project in more detail. Bar charts at this level of detail (Level 0 or 1) show little more than the strategic dates for starting and finishing major portions of the overall project along with a few milestones. For example a bar showing foundations to a process unit on an oil refinery might be a summary of foundations to 20 separate areas or items of plant in that area. An attempt to schedule a larger project in detail on bar charts loses most of the advantages of their use. The schedule becomes unwieldy and difficult to interpret, and users run the risk of losing control of the project time plan.

Naturally these difficulties remain when evaluating acceleration proposals that are based upon bar charts. There is no way for the evaluating third party to know whether the activities to be accelerated are critical or what the impact on completion might be. This, from the employer's perspective, is undesirable. It would not be in his interest to accelerate non-critical work, as it would not impact the completion date unless those activities became critical as part of acceleration of other critical activities.

Notwithstanding these difficulties and concerns and notwithstanding development of other scheduling techniques (see further below) use of bar chars is still prevalent. It goes without saying that may attempt to prepare acceleration proposals or to evaluate proposals based upon bar charts alone is likely to be fraught with difficulty. An understanding will be required at least of logical relationships between activities before any evaluation can be attempted.

For those managing larger projects, further difficulties were evident with use of bar charts. With thousands of activities, there was a real need to be able to prioritise between those that were important at any one time and those that were not. When pressure was imposed for the time for performance to be cut, and the cost of the project be controlled, a means was required to achieving this control which the bar chart did not offer. As the size and complexity of projects grew in the late 1950's and 1960's, finishing projects late became the rule rather than the exception. Late completion, along with their associated cost overruns, caused increased pressure on owners and contractors to develop improved scheduling techniques to facilitation prioritisation. To their aid, the critical path method was formulated.

Critical path method

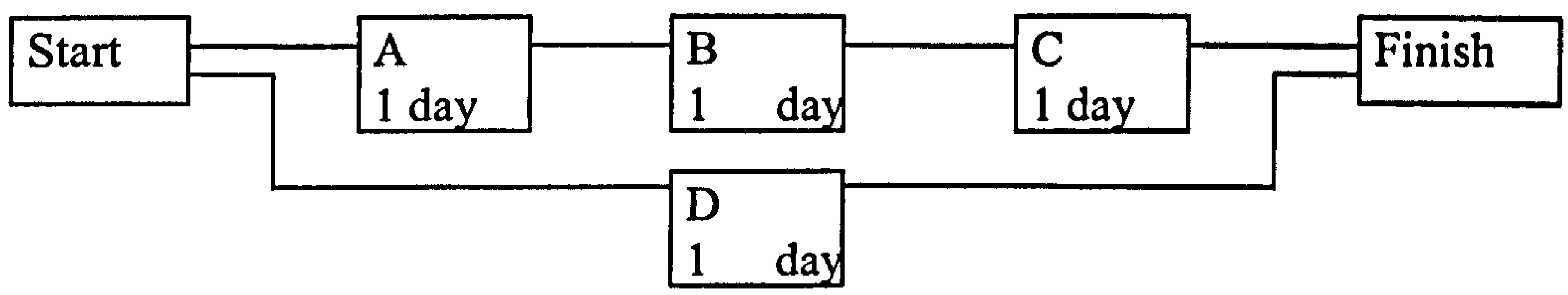
By 1939, following the writings of Weber, Fayol and Urwick, the first appearance of the horizontal or task form of organisation emerged in the academic writings on management. A separate management team was required for managing the project within the client group as project management through the conventional management structure was inadequate. In 1956 the US Air force developed a Special Projects Office for development of the Polaris missiles. The team employed contractors for the bulk of its Research & Development management support and procurement. By 1961, an estimated 250 prime contractors and 9,000 subcontractors were working on the programme. The need for a detailed control system was identified with the following criteria: a careful time estimate for each activity, no matter how far in the future; a probability distribution for the times that the activity might require; and precise knowledge of the sequencing required or planned in the performance of activities. From this was to emerge PERT (project evaluation and review technique) which incorporated the technique of networking and the identification of the 'critical path', i.e. the sequence of events in the project that required the longest time for completion.

Meanwhile, the Central Electricity Generating Board in UK developed a technique to identify 'the longest sequence of events' in the overhaul of generating plants, a precursor to the 'critical path'. At the same time, Du Pont in USA developed the CPM (critical path method). Like PERT it used a network diagram, comprising activities which were represented by arrows, which emphasised the relationship between activities. As Du Pont's focus was on construction work, where the technology and process were largely known, its method naturally emphasised activity duration whereas the USAF emphasised the probability of durations. Du Pont was operating in a commercial environment where costs mattered greatly and thus developed CPM, as CPM could accommodate both cost and resources, and allowed calculation of optimum costs and schedules. By the early 1960's CPM prevailed, particularly for use in construction, largely because it dealt not only with costs but was also capable of dealing with resource allocations. In 1961, Fondahl developed the precedence method of networking to overcome difficulties with computerisation of the arrow method. The precedence method also allowed use of lags; time lags before and after the start and finish of activities. It was not until the second half of the 1970's that the precedence diagramming method became more popular. The period also saw the development of work breakdown structures, estimating methodologies and cost and scheduling monitoring and reporting systems.

The strongest advantage of PDM (Precedence Diagram Method) systems over the older 'on the arrow' systems is its ability to show lead and lag factors - when an activity can start before the preceding one has been fully completed. Most present day computer based scheduling programs are PDM based systems.

By the 1960's, a second basic scheduling methods, the logic-diagram based schedules was available to supplement or as an alternative to bar charts. The bar chart or time scaled charts were usually very good visual aids, and needed little explanation, whereas network diagrams can appear strange and unfamiliar at first sight. They are not drawn to scale, but simply show all of the tasks in their logical juxtaposition. Although networks are weak in their ability to set out tasks on a time scale they have other strengths. When compared with bar charts (including linked bar charts) critical path networks provide the more powerful notation needed to show all logical inter-dependencies between activities. The planner can ensure that, for example, bricklaying will never be scheduled to start before its supporting foundations are ready. Such errors are easily possible with complex bar charts, where the constraints cannot all be shown or remembered (Lock, 1996, p.141). The basic logic diagramming principles developed in 1960's are still in use today. In 1980's the development of relatively low cost computers made the use of the CPM system possible for even the smallest companies.

An illustration of how CPM scheduling techniques works, at its simplest, is as follows. Take a project with four activities to be done, A, B, C and D, and assume that A, B and C must be done sequentially whereas D can be done concurrently with all three. The project cannot be finished without all four activities being completed. Using 'precedence' notation this would be illustrated thus:



If each activity takes 1 day to complete, how long will the project take to complete? Under the conventional or standard approach to CPM, whether calculated on the arrow or precedence method, the answer is 3 days. Thus, activities A, B and C are described as being "critical", in that a delay to either A, B or C will delay completion. Activity D on the other had need only be completed within one day, whereas it has apparently a three day time window in which this work can be done. This activity is said to have 2 days float. From this simple example, it can be seen that a computer is not needed to prepare a critical path analysis, but a computer would certainly help where the project has over 20 activities; the total project duration has been calculated; and a differentiation is drawn between those activities that are critical and those that are not, thus aiding management of the project.

An incidental result of CPM was that it also would produce a list of the dates on which each activity would start and finish. In the case of the above example, activity A can start on day 1 and should be finished by the end of that day, B should start on day 2 and finish on that day, C should start on day 3 and finish on that day, but D might start as early as day 1 (the early start date) and finish as early as the end of day 1 (early finish) or it might commence as late as day 3 (late start date) and finish on that day (late finish date). In this way, CPM can be used as a project control plan.

Thus CPM was a facility which highlighted, once activity durations were predicted and once the relationship between activities was understood, which activities were critical to completion or 'on the critical path'. The length of time taken to complete activities on the critical path was the time the project would take. The second difficulty which project managers faced, which drove development of scheduling techniques, was to answer the question, when faced with a multitude of tasks that might be carried out: "which tasks should receive priority?" Again, CPM was the facility that allowed this question to be answered. Activities on the critical path were those which, if delayed, will lead to a delay to the project completion. The other activities would carry 'float'. Normally fewer than 20% of project activities will fall on the critical path, so CPM is a Management-by-exception technique. Thus, given the choice between carrying out critical work and work which had float, the answer, according to CPM, was to give priority to the critical work.

Initially, and up to mid 1980's, there were three criticisms made of CPM-based scheduling as a controlling mechanism. First, mathematical analysis by hand was very cumbersome and for any project involving more than 30 activities really needed to be computer based. Second, the diagram (whether on the arrow or precedence basis) upon which the technique was developed was not readily understood throughout the industry, particular by staff who had trained before 1970 or who were trade based. Third, because of the configuration of the diagrams, they could not be easily amended by hand and it was difficult to see at a glance to see what work was to be done at any particular time. Each of these difficulties was soon overcome in mid 1980's through development of project management scheduling software which was cheap, easy to use and flexible, and could produce results in bar chart form or tabular form and could be easily updated.

In the late 1970's CPM based programmes had fallen out of use, both in UK and USA. In mid 1980's difficulties with the use of CPM systems came to be resolved. The breakthrough came with development of the personal computer in about 1980 and the rapid fall in the price of personal computers. Initial benefits were that planners could use computers themselves rather than relying upon systems colleagues to process data. Thus, the planner could quickly prepare programmes, add resource links and update computer-based networks to reflect changes in the project and show the impact of project progress.

Low cost project planning systems came to the market that allowed a CPM based network analysis to be published in bar chart form. Further developments was use of linked bar charts which purported to show relationships between activities, and bar charts, perhaps in colour, showing float for each activity. These developments allowed the advantages of both CPM, as a form of analysis and bar charts, as a presentation system to publish the results of that analysis to be harnessed together.

More recent software developments allow work activities to be coded, thus facilitating output in barchart form of a selection of activities. Thus, the construction manager might print out all work to one area of the building, all work of one particular trade, all work to be done by a particular date or all critical activities. Similarly, CPM systems, where delivery of materials is introduced as activities, can highlight which particular deliveries need to be made by particular dates.

Two further benefits of computerised CPM scheduling are the ease with which what-if analyses can be undertaken and the capacity for the schedule to be regularly updated with current progress and recalculated on that basis to show which activities, in the light of that progress, are critical.

In the late 1990's availability of computer-aided project planning is widespread. Pickavance (1997) lists over 200 software packages for project management work. For planning of construction work, the use of planning software with graphical interface is common, particularly on capital projects valued over £500,000. Examples of software frequently used in UK include Asta's Powerproject, Microsoft Project and Primavera. These allow projects to be drawn in bar chart (Gantt chart) format and allow relationships between activities to be represented. Indeed so simple is Microsoft Project to use that project managers in the commercial and banking sector frequently use it to plan relocations and internal projects. More complex programmes include Primavera and Open Plan which allow a common body of planning data to be represented in either bar chart of diagrammatic form, thus combining the benefits of networking to define with precision the relationship between activities, and allow reports to be printed in bar chart form for ease of interpretation, showing critical activities and float. It is significant to note that these software packages are being used worldwide. The use of bar charts and planning software is now commonplace, particularly in North America, Europe and Australia.

The last section above considered in outline the development of techniques and facilitates made available by software houses. The genesis of logic-based scheduling, however, is very different to preparation of bar charts. It is really only a mathematical means of scheduling activities and is not without criticism.

IT developments in recent years have had an influence on programming which is notably adverse. Computers were first used for mathematical modelling, that is, undertaking complex scheduling of activities and generating results. A significant development in 1980'and 1990's was the development first by Apple and then Microsoft of the graphical user interface, the use of the mouse to control a cursor and icons on screen. Software was produced which allowed pictures to be drawn on screen. Regrettably, some planning software is no more than a package to present pictorial results: its powers of scheduling may be very limited. The capacity to adjust the picture to meet the planner's wish can result in bar charts being produced with little or no logic links. Worse still, some packages allow lines to be drawn between activities as the user wishes providing the illusion of a barchart with logic links when in fact what is shown is merely a hand prepared diagram, prepared without any logic links or activity scheduling.

A theoretical advantage of the CPM system, identified in particular by Ritz (1994, p.134), was that it forced project teams to dissect the project into all of its working parts to allow the schedule to be prepared. There was simply no way that planners could plot a result with no calculation or thought supporting its relationship with other activities. This forced the early analysis of each work activity. The time and discipline required to prepare CPM schedules was another reason for their temporary demise in 1970's. It is perhaps regrettable that the development of 'drop and drag' planning allows preparation of bar charts with activities linked in a way which may dispense with any serious consideration of how the work is achieved. The ease with which schedules for earlier projects can be modified to suit other projects exacerbates this problem.

In summary, availability of low cost computing has facilitated development of low cost industry-standard software which in turn has encouraged widespread use of computers for programming. Ease of use of software as a drawing tool has facilitated production of programmes with little consideration of work to be done, relationships between activities or resources. The result may be a schedule that appears sound and considered but which may have been prepared without much detailed analysis.

3. Resource scheduling techniques

The need to consider resources

Notwithstanding development of scheduling techniques that could schedule activities and show results in bar chart form for easy consumption, the results, for some managers were useless or impractical if followed. They required huge variations in the quantities of resources deployed on site day by day. It was simply not possible for site managers to engage and release resources as frequently as the programme suggested. In practise it would be difficult to secure labour at short notice, so execution of some work would be delayed. Later it would be difficult to keep the full site labour force engaged full-time. In response to this problem two techniques were developed to smoothen out the day-to-day resource requirements. Planners themselves provided the first solution. They merely needed to link activities that required the same resources into a sequence, thereby ensuring continuity of that gang. The logic links of this nature are usually referred to as being 'preferential'.

> For Example: A project to build a swimming pool complex required tiling in many locations, particularly to three pools and changing rooms. The contractor decided to have two teams, one for pools and one for changing rooms. Logic links were inserted between tiling to the completion pool, tiling to leisure pool

and tiling the outside pool in order to ensure that these were undertaken by the same team of men working in sequence completing one pool before moving on to the next. The logic links were, strictly speaking not necessary, as they were merely contingent upon the level of resources and a general decision as to which pools might be completed first.[445]

There are three objections to use of preferential logic. First, it is not clear to a third party observer which links might be preferential and which are necessary. Second, it will not be clear to any third party observer why preferential links were used in particular ways. This in turn means that were acceleration to be considered by addition of particular resources the impact of this on the completion date may be very difficult to determine without an understanding of logic used. For this study a clear conclusion emerges: programmes that incorporate preferential logic as a means of dealing with limited resources make poor models against which acceleration proposals might be tested.

The second response to resource smoothing has a mathematical basis. Essentially a scheduling algorithm is first run to determine the critical path and is then re-run to adjust the timing of non-critical activities within their float time to smoothen out resources usage. Critical activities may also need to be adjusted where resource limits are specified. Most scheduling software available incorporates some resource smoothing facility.

There are two difficulties with computer-based resource smoothing. Considerable effort is required to input against each activity the type of resource required to separately stipulate likely resource limits. Computers are excellent at providing the facility to calculate the likely date for completion with alternative resource limits. As higher limits are introduced it is harder to identify non-productive periods. The practical problem is that use of resource features in programmes by planners is rare generally, let alone when acceleration is planned. The second difficulty is that different levels of resources have different productivity or efficiency levels and performance may be contingent upon differing plant

[445] Construction of Aylesbury Vale swimming pool, with which the author was personally involved.

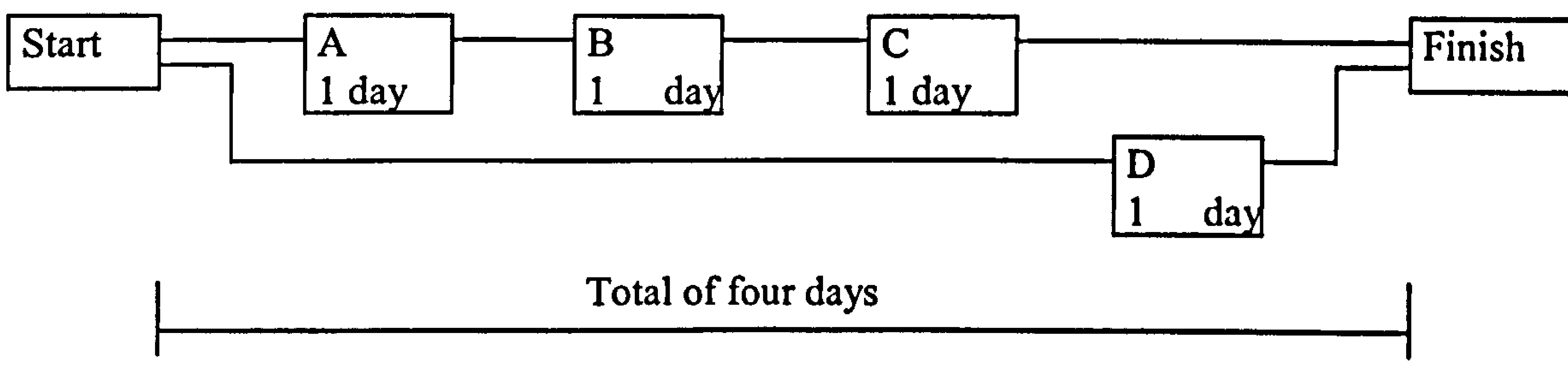
requirements. These are difficult to model in planning software and ought not to be overlooked when rescheduling for the purposes acceleration proposals.

Until recently many writers on CPM and generally on planning and scheduling (Cooke and Williams *(1998)*, Harris and McCaffer (1995), Oxley & Poskitt (1987) Pilcher (1992), Reiss (1994, p.187) have tended to regard resource scheduling as an optional activity. CIOB (1981) make no mention of resource scheduling at all. These views, it is suggested, can cause network analysis to produce unreliable results where the resources required for particular activities, or the project as a whole, are limited or where capacity to make incremental increases in the supply of resources is limited.

Lock (1996, p.181) acknowledges, and explains, the need to deal positively with resource constraints. He notes that a network cannot normally be used by itself to demonstrate the volume of resources needed at any given point in project time. In fact, when the network is drawn, no considered account can be taken of the resources that will be available. The start of each activity is usually assumed to be dependent only upon the completion of its preceding activities, and not on the availability of resources at the right time. In general, network logic shows those constraints between activities that are related to the logical, preferred sequence of working. Thus, although the network may be fine in logical theory, it is unlikely that all of the activities can be scheduled to start at their earliest possible time. It might be impossible to carry out the project in the time indicated by the critical path owing to the additional constraints imposed by insufficient resources.

Consider how logic based scheduling works, using the same example as above with four activities to be done, A, B, C and D, and assume, as before, that A, B and C must be done sequentially whereas D can be done concurrently. If each activity takes 1 day to complete, how long will the project take to complete? Under the conventional or standard approach to CPM, whether calculated on the arrow or precedence method, the answer is 3 days. Thus, activities A, B and C become critical, in that a delay to any will delay completion, and D has 2 days float. The difficulty with this analysis is that it presupposes unlimited resources. What happens if there is only one man available to do all tasks, for instance?

Clearly the work will take four days to complete, with one task being completed on each day. One reaches the somewhat surprising result that the project would take *longer* than the 'critical path', calculated without consideration of resources, suggested.



Thus, Lock regards network construction and time analysis are seen as the first essential step in the wider process of scheduling resources. Resource constraints need to be treated as a separate issue, requiring at least one more stage of scheduling after determination of the critical path and float.

This analysis highlights a potential difficulty with any CPM-based analysis: results may be unsound without consideration of resources. This may affect both the scheduling of activities and total project time. Has this apparent deficiency passed unnoticed? White (1985) observed that a discrepancy had developed between the critical path scheduling techniques and construction practice. His principle observation was that the critical path method may be efficient at scheduling activities, but this may not model how construction work is in fact carried out. When this remark was made, some 14 years ago, few inexpensive project planning software packages were available which integrated resource planning. White noticed that contractors are primarily interested in maximising use of their resources on site, by ensuring those resources were used continuously without waste.

Resource scheduling methods

There appear to be two positive means by which resource limits can be considered as part of the planning process, through use of network logic and through network based smoothing through resource identification and allocation.

Resource constraints

If a network has been produced using only technological constraints the resource demands will be intense early in the project, if scheduling is based on early start times (EST), or the demand skewed to later in the project is scheduled on the basis of latest start times (LST). Since, as Mawdesley et all (1997, p149) observe, neither is desirable, it is common practice by planners to introduce further artificial constraints, what Mawdesley et al refer to as resource constraints, into the network. These are constraints which look like, and have the same effect as, technological constraints but which are there solely to ensure that the resource use in the EST schedule is reasonable and practical. As an example, in a railway building contract which requires several bridges to be built, it may be that additional constraints are added so that the same construction crew complete one before undertaking the next, and so erect the bridges sequentially, whereas it may be that all bridges could be erected concurrently.

As Mawdesley et al note (p. 150), since changes caused by such varied things as client decisions, contractor preference, weather and unforeseen conditions occur very frequently in most construction projects, it is recommended that resource constraints are not included in networks.

Difficulties with use of artificial resource constraints in network diagrams often surface in dealings with subcontractors or works contractors. Not untypical is a situation where the construction manager prepares a master programme at an early stage with little or no input from subcontractors or works contractors. It is only when subcontractors tender for the project that it becomes evident that certain work sequences may need to be re-arranged or durations increased to accommodate subcontractors interests. The consequences of the construction manager's failure to consider resources, particularly when the resources involved are inflexible and expensive to establish and remove such as cranage and piling equipment, can be significant. The subcontractor asked to carry out diaphragm walling around a large site, within a period of 4 months, may be faced with the dilemma of whether to introduce one piece of plant and finish in 6 months or two plant units and finish in 3 months, perhaps at considerable short term expense. Neither may suit the construction manager, and the construction manager may already by the stage of letting the diaphragm wall contract, have committed other contractors to working to periods or sequences which presuppose that diaphragm wall work can be done in exactly four months.

The difficulty with preferential logic is that if consideration is given to increasing resource levels this will not be properly reflected without manual rescheduling.

Resource limiting

Most planning software packages now contain facilities for handling resources and for scheduling to be integrated with or based upon resource assumptions. There are, it is suggested two noteworthy uses of computer-based resource scheduling, to reschedule the project in the light of inflexible resource limits, and to test the impact of increasing resources.

The more sophisticated planning software contains facilities which allow resources types to be assigned to each activity, and a statement made for the purpose of scheduling that the resource is limited to a stipulated number of units per day. The schedule can then be calculated on that basis.

Lock notes (p. 190) that in practice the contractor faced with carrying out work in a shorter period to that which the schedule indicates is required due to resource constraints will plan to complete the work within the shorter period, accept that additional workers will be needed, but review and adjust the resource-aggregated schedule in an attempt to smooth the workload into a more cost-effective pattern.

The approach to resource scheduling will be governed by the choice between two planning options or priority rules, namely whether the schedule should be resource limited or time limited. The choice between these two rules must be made whenever there is a clash between meeting a project completion date and finding the necessary resources (Lock, p. 196).

Lock's view (p.199) is that to be practicable, every project work schedule must be achievable. It is suggested therefore that failure to consider whether some or all resources may be limited results in the risk that the schedule cannot be achieved with the limited resources.

Different software packages may handle resource allocation differently (Mawdesley et al (p. 163)). The duration and resources assigned initially are usually the optimum, meaning that the resources allocated are usually the smallest required to complete the activity in the normal duration. It will suffice here to refer to factors making project resource modelling complex

1. By increasing the resources the duration is decreased, but the relationship is not linear. There will be a practical, and a physical, minimum time required to carry out the work involved. A reduced duration is sometimes referred to as the 'crash' duration. By continuing to increase resources the cost will nevertheless continue to increase.

2. By decreasing the number of resources, there is a minimum number of resources that are required to achieve any progress at all. Thus, there is a minimum cost involved with all activities.

3. The relationship between resources and duration can be complex where an activity comprises multiple resources. To maintain a practical model, some assumptions will need to be made as to the mix of resources (such as the mix of labourers and bricklayers in bricklaying gangs) so that single resources (bricklaying gang, for instance) are assigned to activities.

4. It should not be assumed that the rate of activity will be constant throughout the activity. Some splitting of activities may be required to reflect this.

Mawdesley et al (p.168) highlight these difficulties and note above all the need for the planner to understand how it is that the software being used models resources, activities and durations in question. It will suffice to note here that if 20% of a schedule's activities are critical, and all 100% use the same resources, the results of any exercise to reschedule based upon increased resources will depend on whether the increased resources are assigned to activities on the basis of the activity's existing duration, or extent of float. The danger to be avoided is that the increased resources are assigned by duration. With 80% of the activities non-critical result all expenditure on those activities resulting in decreased durations would be apparent wasted expenditure, as it would not result in a decrease in the project duration.

Concluding remarks

The length of time taken to carry out the project is, ostensibly, a function of both the duration of its constituent activities and the logical relationship between those activities, the relationship in which each must or might be carried out to achieve successful completion. Durations may be estimated or calculated in a variety of ways but are often arrived at less than scientifically. Even when calculated, those calculations may be based on sweeping assumptions as to the level of resources intended to be deployed and level of output achievable and durations may be adjusted in any event for a variety of other reasons.

Failure to specify resource constraints can lead to misleading schedule calculations. Use of preferential logic to reflect resource constraints results in an indistinguishable mix of necessary and preferential logic and loss of the facility to test what rescheduling might be achieved with adjustments to resource levels. It was also noted that, notwithstanding developments in recent years to facilitate accurate scheduling of projects and resources, it is possible for programmes to be produced in bar chart form without any real thought being given to logical relationships, without any detailed analysis or worse, possible for analysis to be done but hidden through publication of the analysis in bar chart form.

In summary, it cannot necessarily be assumed that material illustrated on a programme means that work is achievable in the sequence or duration shown on the programme or that the contents of that programme reflect the methods or sequences in which the contractor planned or intends to carry out the work.

D. Programmes, delays and acceleration

Key questions to be asked, posed earlier in this chapter, are how much time needs to be saved through accelerative measures, and how best this can be achieved. At its simplest, acceleration involves three components: a reported delay to construction, a brief exploration or discussion as to what can be done, followed by actions of some sort aimed at increasing the rate of progress. Measurement of the extent of delay has a direct bearing on the extent of acceleration required.

Calculating how much time needs to be saved requires, first, an understanding as to the state of progress at a particular point in time and understanding, from that, the likely date of completion: this will indicate whether, or to what extent, completion might be delayed beyond the contractual date in fact required by the employer. In view of this, programme and progress reporting issues are of particular interest in this study, and are of particular importance to the employer. When progress is poor, it is not the programme itself that is of interest, but the progress report that indicates that the works are not proceeding to plan. Knowledge on the employer's part that progress is poor, or the desire to achieve progress faster than planned, is a necessary condition for acceleration decisions.

Progress reporting is also highly relevant to the price paid for accelerative measures. If delays are under-reported, then more acceleration will probably be needed to achieve completion than first thought, so increasing costs incurred. If over-reported, the employer might arrange and pay for acceleration that might not be needed at all – he will effectively have been subsidising the construction operations. For the employer a sound understanding of planned, actual and likely progress may be crucial if he is to avoid paying for accelerative measures that arguably were never required at all. Equally, for the contractor a sound understanding of planned, actual and likely progress is crucial to avoid calculation of a price for acceleration that is later found to be inadequate. Either way, measurement of progress achieved, and reporting mechanisms adopted, have a crucial bearing on the amount of acceleration required.

Progress reporting generally

Progress is a function of the nature of the tasks to be performed, the sequence of performance of those tasks and the resources applied to achieve the task. A single task such as the movement of the hands on a clock, will show continuous, uninterrupted and regular progress so long as there is nothing to interfere with the task (movement of the hands) and the resources (in this case energy or power) applied are regular, whether they be a battery or power supply or by the winding mechanism. The progress made by a car will depend on the sort of road upon which it travels (the task) and the amount of petrol introduced to the engine via the accelerator and the mix of fuel and air, (the resources and the proportions in which they are applied) and the extent to which obstacles are encountered. Measurement of the rate of progress of tasks whose rate of performance is linear or constant is comparatively easy, and in respect of those same activities it is comparatively easy to predict when the task might be completed.[446]

Construction projects typically involve a very large number of disparate activities, some for which rates of progress will be linear and predictable, others with highly variable progress rates. Hence, the time required overall is a function of the time required for individual activities, the sequence in which the activities are to be carried out, together with any constraints. In view of this complexity of activities to be carried out and relationships between them, a project will usually be planned in advance of construction, with the planned sequence and duration of activities shown on the programme. It is against this (or an updated version of the programme) that progress will most probably be measured. Measurement of project progress therefore must rely upon a two stage

[446] Details of planning principles relevant here are set out in more detail in Appendix E.

approach: first, an understanding of the state of progress of each activity or task to be performed, and second some means of measuring progress overall, when the individual tasks are viewed collectively in the context of the whole.

As project progress is the sum of progress being achieved on project activities, it follows that the rate of progress achieved overall will depend on (a) those activities which have been completed; (b) whether activities which, are critical at the time the work is being done are being progressed and (c) if so their rate of progress. Thus, from week to week the rate of progress being achieved overall in particular sections or areas of the work, or overall, will vary. Indeed, so long as the critical path changes from activity to activity from week to week, achievement of precisely similar rates of progress from week to week would be no more than a co-incidence. Measuring progress of construction is complex. First there are no fixed road-markers to identify extent of progress. Second, to the extent that there are identifiable stages, such as completion of foundations, start of steelwork erection, date when the building is weather-tight or date of power-on, the calculation of how long it might take to reach each date differs from project to project.

Acceleration aside, planning and programming are of significance to both contractor and employer in any event for performance of the works. For the contractor, the programme is a working tool used in preparation of the tender, to plan in detail how and when each particular element of the work will be undertaken, to identify dates by which information and materials from third parties will be required and to provide a benchmark against which progress is measured. It is a tool for presentation of progress information. For the design team, programmes provide a valuable insight into when certain areas of work are due to be carried out and design information required. For the employer, whilst he can watch work progress on site, the programme provides a useful benchmark against which the state of progress might be measured. In considering acceleration, programme matters therefore take on a particular significance as the key tool used to measure progress.

Ascertaining an accurate view of the likely date for completion through progress measurement on projects, though apparently simple, is fraught with difficulty. The traditional view of progress was that measurement and reporting of progress was a matter for the contractor. The contractor prepared the programme and would report progress against the programme on a monthly basis. According to the traditional view the employer's interest in progress was limited to three matters. First, as he was paying for work as it proceeded, he needed to know how much work had actually been done. This task of ascertaining the quantity of work done, and its corresponding value, he left in the hands of his quantity surveyor. Alternatively, payment was made on completion of stages. Second, the architect was concerned to release detail designs sufficiently in advance of construction so as to avoid a contractor's complaints of delay. Third, the architect knew that in the event of delays to progress he would have to decide upon a period for extension, where appropriate. Evidence of poor performance without explanation would always provide useful evidence of a contractor's failure by way of a foil against a contractor's time claim.

Essentially progress measurement from the contractor's perspective may be a process carefully managed in order to protect the contractor's economic interests. The employer on the other hand may be frustrated by the lack of information available or inability to test the data, to question the contractor on discrepancies or to independently calculate the true overall position. As will be seen later, virtually all writing to date on progress measurement ignores the impact of both contractor's and employer's interests. In the context of acceleration proposals these can be very important.

Progress reporting: the contractual setting

There are a number of contractual provisions of significance here. First, virtually all construction contracts require the contractor to provide a programme of some sort. It is common practice in UK for further stipulations to be set out in specifications requiring the programme to be in bar chart form, to show the critical activities, that the programme is updated regularly and that a progress report is provided monthly. Whereas some employers on large process engineering projects are known to request digital copies of the programme, and digital copies of all progress updates,[447] this is seemingly not common practice in UK, either for process or other work. The sum of this is that the employer tends to be largely reliant upon the contractor for progress data during the project.

The second near universal provision is that the contractor will incur liquidated damages in the event of delay. Coupled with this is invariably an extension of time provision, allowing more time to be granted in respect of a limited range of causes of delay: this provides relief against liquidated damages that would otherwise be incurred had the project run late. Thus, for some delays, such as employer changes an extension would be awarded (assuming of course the change affected activities on the critical path), but there would be no award for a delay of the contractor's own making. Coupled with this is typically a notice provision, requiring the contractor to put the employer on notice as soon as the problem arises, of any matter for which an extension of time might be sought. There are also provisions for the contractor to recover time related costs incurred and losses in respect of defined causes. The sum of all of this is that contractors can be expected to adopt caution in progress reporting. They will typically be quick to identify causes for which they might be granted relief; they will be very slow to admit to delays of their own making. This embedded self-interest has a very significant impact on progress reporting.

Progress reporting: the textbook approach

According to Lock (1996, p130) a project manager must be able to answer two complementary questions at any time in a project: Where *should* we be on the plan now?; and Where exactly *are* we on the plan now?

The project manager, it is suggested, will only be able to answer the first question if he has a plan facilitating objective day-to-day measurement against intermediate events. The second question is largely concerned with use and presentation of progress data. But

[447] Also becoming more common between subcontractor and main contractor.

Lock's two questions, it is suggested, are insufficient. They relate only to the present position, but should extend to cover future completion objectives. If the project manager can see that some work is not proceeding to plan, he must surely ask himself two further questions: When is the likely completion date, having regard to progress to date? What actions can be taken to recover delays, and to what effect?

The project manager should also be able to ascertain answers to all of these questions posed above.[448] It is reasonably clear that contractors are able to answer these questions, even in rudimentary form. But it was consistently clear from case studies that a project manager, or other construction professionals acting for the employer, will probably not be able readily to answer these questions. The means by which progress to date, and the likely date for completion, are communicated between contractor and employer therefore bears further study.

Despite Lock's views, surprisingly little has been written about progress reporting. This may be because it is rarely of real interest on projects, in that if reporting is marginally incorrect it will be of little consequence, provided the end date is achieved. But progress information, and its reporting, is of greater significance where a decision is being made to accelerate. Much of what is written[449] is concerned with measurement of progress. Thus, much is said of critical path analysis and collection of data, and generation of a progress reports utilising computer-based scheduling systems.

According to the textbooks there are two key stages to progress reporting: the publication of an initial programme showing the critical path; and subsequent publication of progress reports. The more basic texts, such as CIOB, merely advocated that the report should show, for each activity, their planned and actual commencement and completion dates, and percentage progress achieved. Other more modern texts, particularly those grounded

[448] In addition, an understanding of what caused the delay may have a significant bearing on the project accounting, as this will determine whether delay damages are payable by the contractor in the event of late completion or whether the contractor might be entitled to receive time related delay costs incurred.

[449] Lock (1993), CIOB (1988, 1991, 1996), Mawdesley et al (1997), and Cooke & Williams (1998)

in computer-based reporting, anticipate also that progress information will be used to project the dates for commencement and completion of work yet to be carried out, and thus provide a projected completion date. The likely date for completion is calculated on the basis of the progress information. Some texts also anticipate that some explanations might be provided for variances between planned and actual progress achieved. On the whole, progress reporting is seen as a mechanical, technical exercise. Overall, it is noted that textbooks tend to view reporting from its technical perspective: the reality, as apparent from the case studies below, is that a contractor's approach to reporting is likely to owe more to the contractual and factual setting than the textbook authors suggest.

Progress reporting from case studies

Below is set out an analysis of systems used in case studies to report on progress.

1. Conventional progress measurement

The tabular report, listing progress achieved against activities, was found at virtually all projects in the case studies. This system is typical of that used for measuring and reporting progress within the UK construction industry: it appears to have changed little over the last 30 or 40 years. Typically, the tender documents will require that the contractor submit to the design team a programme within 2 or 3 weeks of contract award. Whilst the contractor may have prepared an outline tender programme for use in preparing his tender, and may even have published this to the employer, the programme prepared after contract award is usually that which is intended by the employer to be used as the benchmark against which progress will be measured during the project. This is usually referred to as the 'Construction Programme', or where submission of a programme is a contractual requirement it may be referred to as the 'Contract Programme'. Indeed it is not unusual for contractors to press for the programme to be used as a benchmark against which progress is measured.[450]

The general approach taken, evident within the case studies, was for the programme to be presented in barchart format containing perhaps 50 to 70 activities. The construction programme typically showed activities to level one only – that is to say at summary level. It tended to show the earliest possible date by which the contractor might start work in particular areas. The provision of digital copies of the programme (for interrogation or use by the employer) was found to be rare. There is a notable increase, in recent years, in the extent to which some logical links are shown on paper copies of the construction programme issued to the employer. Virtually all copies of initial construction programmes showed which critical activities were critical, but few showed float.[451] Later analysis invariably showed that attempts were made to suppress float by introduction of additional preferential links between activities. Also evident was grouping of potentially critical and non-critical work. Both measures tended also to increase the number of activities shown as critical. This favoured contractors: in the event of delay, where the contractor would seek an extension of time should critical activities be affected, it increased the chance that critical work was affected, and thus increased the chance of a positive time award.

From the contractor's perspective such a programme puts him in a strong position vis-à-vis the design team. An information required schedule, setting out the dates by which information is required for key programme activities to be progressed, is typically published based on dates on the Construction Programme. Against these benchmark documents the contractor can compare progress actually achieved and highlight

[450] It is not unusual for the copy of the construction programme presented to the employer to have been prepared specifically for submission to the design team: that programme may differ from programmes used by the contractor to manage subcontractors. The programme that the contractor may work to may be more detailed and, in some areas, may differ.

[451] Some of these programmes were misleading. The programme for the National Exhibition Centre had much float, but none was declared on the version provided to the employer. At Sutton Bridge Power Station the entire programme was copied and reproduced in Excel so as to avoid showing links between activities. At Kings Lynn power station the contractor prepared many drafts before finally settling on a programme that showed matters in a form and sequence that suited the contractor.

discrepancies. For the contractor this can help to support allegations, made later in the project, that receipt of design information was later than the date required to carry out the work on time, and that delayed provision of information in turn delayed progress of the works on site.

The industry convention is that the design team meet with the contractor monthly to review progress, and in advance of that meeting the contractor is asked to provide a progress report. This was evident on all case studies. The report usually contained a table that reported the cumulative planned and actual progress for each activity. Two additional columns would typically be shown, one with a statement of the extent of delay and the other for comments if appropriate. Both planned and actual progress was reported as a percentage. Thus a typical table would read as shown in Table 1 below.

Table 1

Activity	Planned	Actual	Status	Comments
Excavation	100%	100%		
Foundations	75%	50%	-2 weeks	Delayed by bad weather
Brickwork	20%	0%		
Capping stones	0%	0%		
Overall progress:			**-1 week**	

Table 2

Activity	Planned	Actual	Status	Comments
Excavation	100%	100%		

Foundations	100%	70%	-2 weeks	Delayed by bad weather
Brickwork	40%	25%	-1 week	First panel completed
Capping stones	0%	0%		
Overall progress:			**-1 week**	

There are numerous difficulties with reporting on a basis such as this:

First, it is not clear on what date any activity actually started or was actually finished. This may be a matter of some importance in due course were the cause of delay to particular areas of work to be reviewed.

Second, it is customary in this form of report to only provide 'status' information against those activities that are at the time in progress. This tends to conceal the extent of delay incurred in completion of earlier activities. By way of example, in Table 1 it is clear that the brickwork should have, but has not commenced, but the reason for this is not provided. Further, referring to Table 2, excavation work is reported as being complete. This suggests that there is no cause for concern. In fact the activity may have finished several weeks late. The delayed completion of this activity may even explain delays to later activities. Further it provides no clue as to the delay to the start of those activities not yet commenced. One is left to wonder, without a copy of the construction programme to hand to ascertain the answer, whether the capping stones activity should already have started? And if so, how long ago ought that work to have started?

Third, the planned and actual percentages for each activity are invariably subjectively estimated typically by analysis of the construction programme. What if the rate of progress of the activity was not expected to be linear? Reference to the brickwork activity in the table provides an example of difficulties than can, and frequently do arise, with progress estimation. For example, if brickwork was due to take 10 weeks to complete starting on 1 February, it would generally be said that at 1 March, 4 weeks worth ought to have been completed and thus the planned progress of the activity was 40%. This may, of course, be erroneous. It assumes that the rates of progress over each week will be similar, that is that 10% will be achieved each week. It may be, particularly where the work is complex and there are four identical panels to be built, that the first panel will take four weeks, with the second, third and fourth panels each taking, with the benefit of experience of the first, only two weeks each. It can immediately be seen that, arguably, the planned progress after four weeks will be only 25%. This presents practical problems. Inevitably the first panel will take longer to erect as the erection team become familiar with the drawings, materials and the site. If the first panel takes four weeks to erect one can immediately see that, arguably, both planned and actual progress ought to be 25%. Indeed it is not unprecedented for a contractor to commence activities as early as possible, notwithstanding significant project delays, in order to give the appearance that all is proceeding to plan, when those activities ought not to have started at all.[452]

Fourth, the comments made against activities tend to be selective. It is rare for contractors to report on procurement problems or difficulties incurred by their subcontractors that are of their own making.

Fifth, and most significantly, it is not clear how the overall progress is calculated or what the likely effect on the completion date may be. At best, the planner or project manager may have sought a genuine calculation based upon the dominant or critical work. Alternatively the extent of delay may be an average of performance of individual activities, which would often have the effect of underreporting delays to critical work. At worst, the extent of delay may be careful chosen not on the basis of performance of activities but on the basis of the extent to which the delay might be explained as being a matter for which the contractor might apply for an extension of time.

CIOB say (at page 66) that it is the performance of critical activities that counts, and

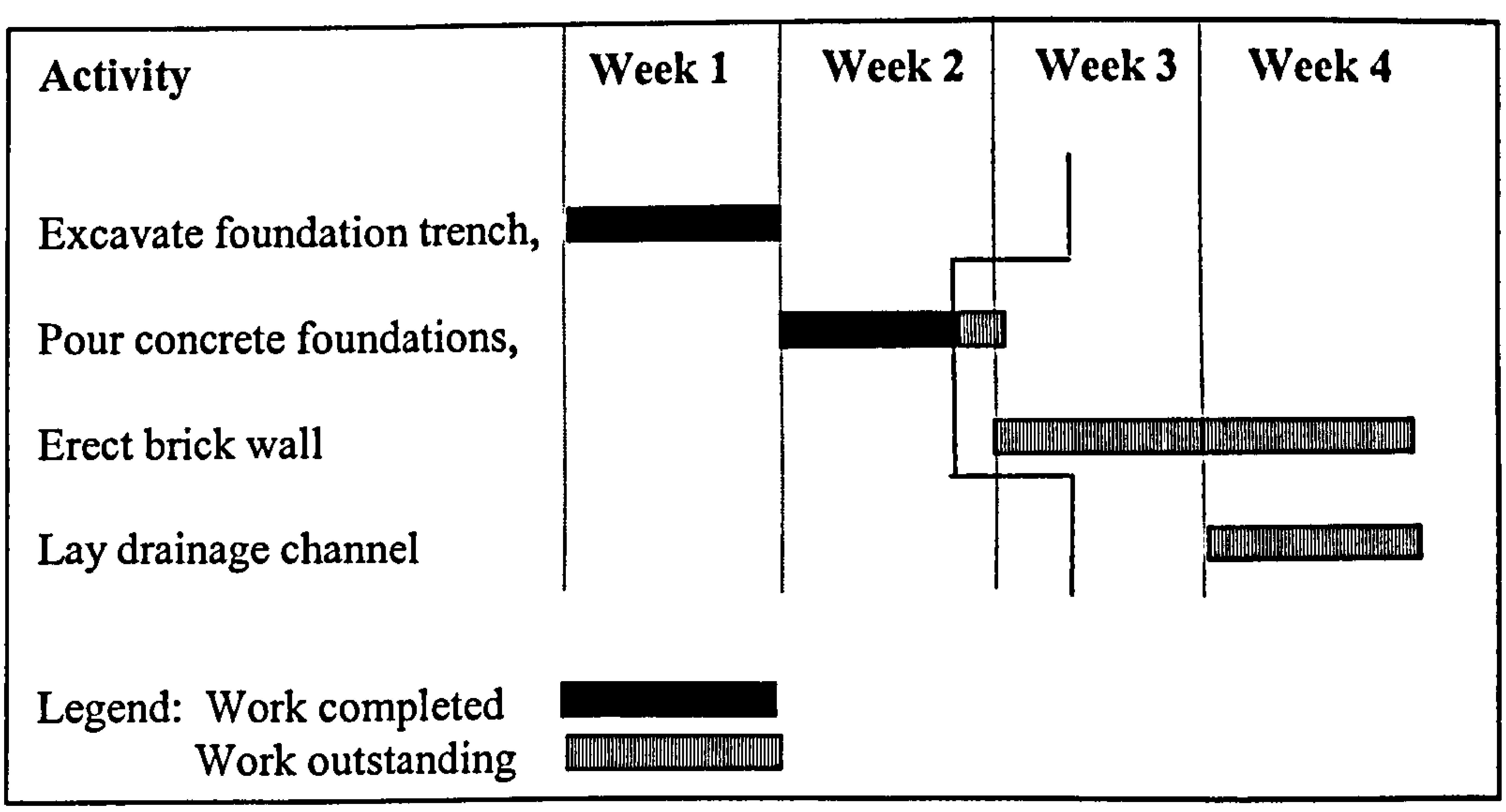
[452] Making a prompt start on activities also was a means by which contractors can avoid difficult questions over delays incurred.

those that are critical will not necessarily be the same as those that were critical when the construction programme was first published. They add that reasons for delays should be noted, particularly where they caused by inadequacies in the programme itself or inadequacies in the information upon which the tender was based. They advise a review of production rates for key activities to allow extrapolation of trends to future work.

Status marked Bar chart

This method of reporting is broadly similar to the table above, in that it shows the same information in a graphical form, such as shown below. These reports are commonly issued with the schedule of progress achieved in tabular form.

Figure 5-2



The status line is drawn at the reporting date, showing against each activity whether the work was complete or not. The criticisms made of the tabular report apply equally here. Arguably, this form of reporting is less helpful than the tabular report. First, no attempt is made to provide comments to explain why some areas might be late. Second, the relevant planned and actual percentages of work done to date are not clear.

It might be added, in respect of both tabular and status marked Bar chart reporting that account may need to be taken of other matters. What if, using the example of the garden wall, the employer required an opening for a gate to be built into the wall, and construction of that opening would take an additional week. There are several ways this might be dealt with:

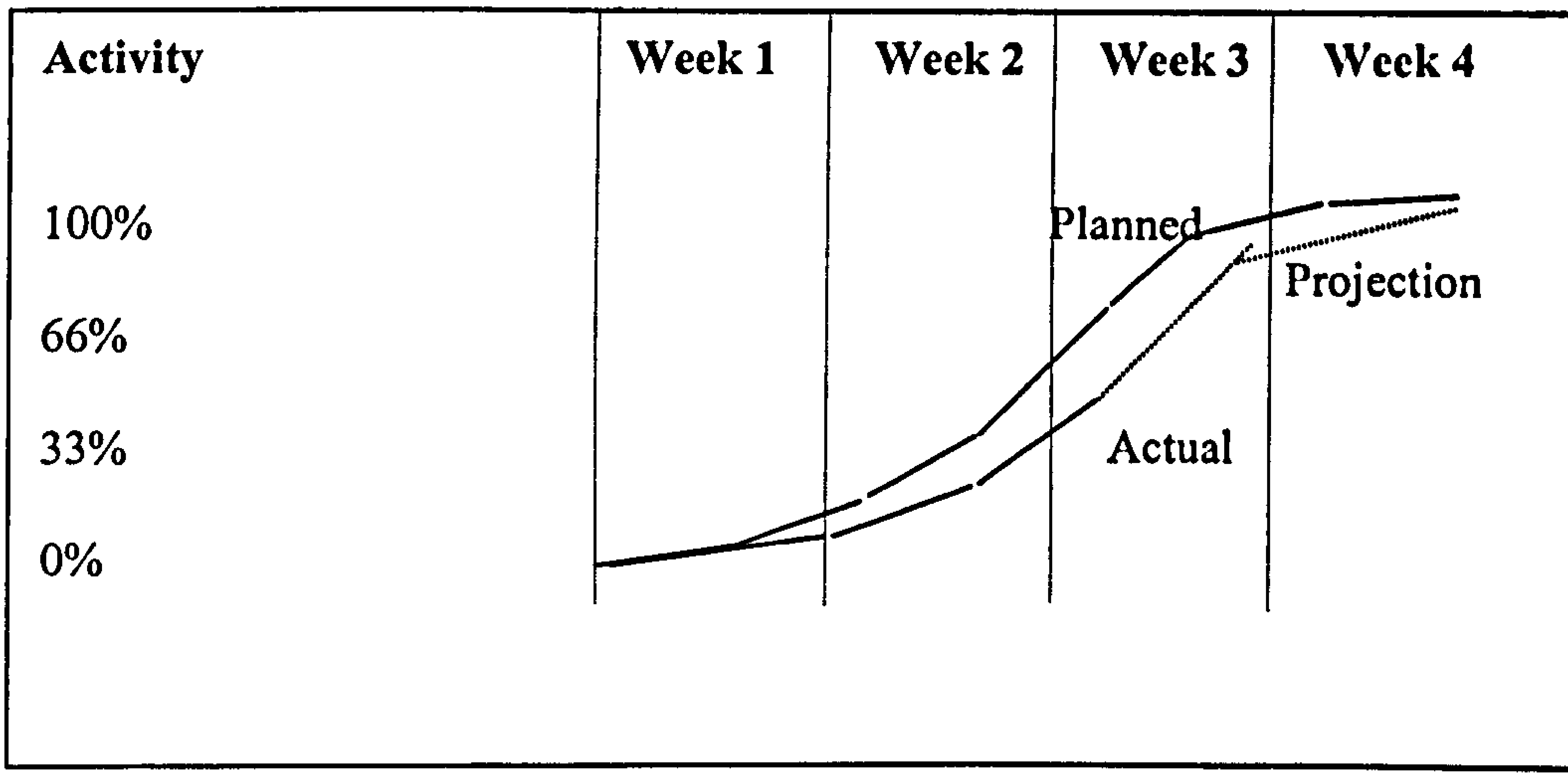
- By amending the baseline programme, against which progress is being measured, to include the additional activity.
- By inclusion of a new progress activity, notwithstanding absence of a baseline activity, showing the construction of the opening.
- By merely mentioning in the comment section that erection of brickwork was progressing more slowly than planned due to the need to incorporate the opening;
- No specific reference is made to the additional work at all.

The latter two are the more usual solutions. What is important to note, perhaps, is that it is not so much the delay that is significant, as the explanation at the time as to the cause of the delay. Parties will have great difficulty recovering progress without an understanding of what delayed progress in the first instance.

S-Curves

The use of S-Curve reporting is common on large-scale engineering projects, and is meant to give an indication of the state of progress either over particular disciplines or over the entire project. The usual form of reporting is to show a planned curve and to overlay a trend line representing progress to date. From this, the distance between both lines is said to represent the period of delay and the line representing progress to date may be extended to predict the date for completion.

Figure 5-3: S-Curve



The difficulties with this form of reporting are many. Clearly the planned and actual percentages, representing an average or sum between the different activities, are hugely dependent upon weighting. If based on value alone, it is quite possible for a contractor, in the early stages of the project to give all the appearance of progress without having completed much crucial and critical work. Second, weighting may be of some use to show that work is progressing at a slower pace then planned, but detail is lost in averaging. It does not, for example, highlight that one crucial area of work may have stopped completely. Third, unbeknown to the employer, the contractor might change the weighting formula mid-project. S-curve charts have two significant limitations: they provide no historic record with respect to the dates when particular activities started and stopped, and they do not highlight those areas of work that are in most need of remedial or positive action. They are of little use without a report from the contractor that addresses these points, and without a regular forum at which the employer might question the contractor.

Practical constraints and issues in progress reporting

Analysis of case studies indicates that progress reporting is far from the mechanical or technical exercise suggested in textbooks, but a carefully crafted aspect of construction management. A number of constraints and underlying issues were evident that go a large way to explain the approach taken by contractors to progress reporting.

- The contractual setting. This was referred to above, especially as explaining why delays may be under-reported until the contractor can supply an explanation for delays for which he might secure an extension of time.

- The Contract programme may be regarded as a restraint. Changes, particularly addition of activities, are an obvious source of questioning from employers. Hence contractors may avoid adding activities simply to avoid exposure even if some were accidentally omitted.

- Some contracts require the programme to be approved by the engineer[453]. Where the contractor changes sequence, it may be that he does so voluntarily without wanting to seek the engineer's consent to a revised programme, or the engineer may refuse to sanction the change. Either way, this can create confusion in reporting, in that attempts may be made to measure actual progress against activities on a programme in a different sequence.

- The frequency with which contractors provide updated programmes is noted. These can be supplied pursuant to an employer's request, possibly following delays and/or changes of sequence. These also appear to be volunteered by contractors, perhaps showing revisions as subcontractor's programmes are incorporated and work is rescheduled. But issue of updated programmes can also suit the contractor, particularly where reordering of activities, changing the level of detail and reflecting altered sequences makes near impossible comparison with previous programmes. This can help the contractor to delay explaining the reasons to delays to some part of the works. It can also allow time within the later parts of

[453] See for example clause 14 under the ICE conditions, 7th Edition.

the works to be compressed unbeknown to the employer: ie, it shows a projected date for completion that is perhaps over-optimistic and which cannot be achieved without substantial acceleration.

- Notwithstanding the above, many employers fail to remember that the construction programme typically only covers construction work. There may in delays in design work or procurement that are not identified. Hence, predictions of completion by a certain date need also to be considered in the light of the progress with design by the design team, subcontractors and supplies and progress of procurement.

2. Reliability of the progress report

What level of confidence is the employer to place on the contractor's progress reporting? There is, it is suggested, a range of factors influencing reliability.

First, what is or is not included in a programme will probably mirror the range of risks that the contractor is to accommodate. Put shortly, the function of a contractor's construction programme is not to show when the project will be completed, but to show when the work contracted for will be completed. Thus, the programme based upon work described in a Bills of Quantities and shown on a drawing may be of a shorter duration than a programme for work to be undertaken by a contractor responsible for both design and construction of the same project. In the latter case, an allowance may be added for a whole range of envisaged difficulties with procurement and design that might not otherwise have been identified by the project team and reflected in tender documents. Before 1994, the question whether time ought to be allowed for work within provisional sums was frequently in issue. By an amendment incorporated in the seventh edition of the Standard Method of Measurement, contractors were deemed to allow for work within 'defined' provisional sums, but not for work with 'undefined provisional sums' or contingencies.

Second, there is an obvious relationship between the programme and the ability and experience of the individual that plans the work to be done. The essential question to be asked, in each case is, to what extent the planner or planning team have had experience of the kind of work involved in the project. Were all construction projects commenced on the basis of detailed and finished designs this would not be an issue. The experienced planner, faced with minimal information will have an idea from previous projects of areas of potential difficulty. Using again the example of a garden wall to be built, a planner might sensibly enquire as to the existence of old foundations in the ground or the existence and location of live drainage pipework that must be avoided or accommodated. The capacity to foresee areas of potential difficulty is particularly valuable in planning temporary works and in developing achievable and realistic method statements. Programmes are inevitably prepared based on a number of unpublished assumptions, assumptions that may only surface during progress of the works.

Third, it may be that the vast majority, if not all of the work, is to be undertaken by trade contractors, whether as subcontractors or work contractors. Whilst care may be taken by each trade contractor to plan his own work, the programme's reliability will depend upon how those works contractors integrate on site. Inconsistencies in the way two or more works contractors working in the same areas approach work are a frequent source of difficulty. Thus, there may be significantly greater risks inherent within a programme that is no more than a compilation of subcontractor works contract periods than one prepared by a planner, with a benefit of a 'masterplan', that questions and adjusts the sequences and methods proposed by each trade contractor so as to ensure consistency with the masterplan. By way of example, a curtain-walling contractor may prefer to install all framing before glazing. For the main contractor building a tower it may be preferable, however, for floors to be progressive glazed at the earliest available opportunity so as to render zones or floors weathertight.

Fourth, reliability will depend in part on the status of the base plan against which progress is to be measured. Taking the simple example of a house to be built, to which the architect instructs, mid project, that a swimming pool is to be added in the garden, it may be misleading to measure progress against a programme that did not show the need to build the pool. The employer may see a programme showing construction of the house as virtually finished when in fact many months remain to complete the pool. It will be important for the employer to understand how the need to complete additional work is factored into the programme.

Fifth, progress data will of course be date sensitive. Whilst the timing of progress data is rarely a matter of difficulty, particular problems can arise upon discovery of defects that require either work done to be tested or to be redone. Work which is reported as being 100% complete, but which requires to be redone, may in reality only be 50% complete if proper regard is taken to the need for defects to be rectified.

Sixth, it is important that those reporting progress against certain activities understand what work the activity on the programme is intended to represent and understand the nature of the work involved. This is frequently an area for debate during projects. Examples of issues raised include questions such as whether an activity called 'mechanical installation' includes testing that installation? Or whether construction of a cofferdam includes design and installation of necessary temporary works? The other common area of difficulty is in estimating the percentage work performed. On construction projects, some tasks will be very regular, such as excavating large areas. Some will show a slow build up, then a regular or linear rate of progress being achieved. Others will be highly variable. For example the purchase of a site will be an intermittent activity, involving various legal procedures, and will end abruptly on completion of the purchase. Design work may also be highly variable in its rate of progress in that initial designs may be left incomplete and completed later on receipt of manufacturers' data. For those activities it is difficult to measure the extent of progress at any one time, let alone predict when the task or activity might be completed.[454]

Seventh, there will usually be some necessary matters that are not reflected in the contract

[454] See further paragraph 4.7.4 et sec in Mawdesley et al.

programme that may be essential to completion of the works. The obvious example is the need for design information from the design team. Others include the need to procure goods and materials, secure planning and building regulations approvals from the local authority, or perhaps employer approval for certain works.

So what should an employer do to better protect his position?

Working from the above material gleaned from case studies and the author's experience, there are a number of issues and points that employers might usefully note if assessing progress data before accelerating.

- Employers should be aware that progress reporting is not a scientific activity. It should be assessed with caution within the contractual and project context. It is not uncommon to find over-optimistic acceleration programmes, and undisclosed ongoing issues.

- Progress reports might deal only with limited ranges of work. Consideration should be given to the state of progress of work that has yet to commence, especially in terms of design, lead times and third party consents. These issues may arise in meeting minutes at the time, without being specifically identifiable on programmes.

- To understand the likely date for the completion the employer should:

    - look at progress of construction, <u>and all other employer inputs;</u>

    - Consider what might be critical, including design and procurement;

    - Seek objectively to understand the various constraints to progress, whether contractor caused or due to matters not of the contractor's making; and

    - Establish underlying issues that might continue to delay progress

XVIII.Appendix F: Acceleration Heads of Terms checklist

A. *Preliminary issues to address:*

- What are the employer's completion objectives?. This requires consideration of sectional completion, even if the contract had hitherto made no sectional completion provision and consideration of the relative the value to the employer of early completion of particular areas.

- What are the consequences of revised completion arrangements on design and construction of the balance of the works? If part of the facility is to be completed early it may be that a different commissioning sequence is required, or a sprinkler system design to operate throughout the entire building has to be altered to facilitate use in one part of the building only. Thus, the parties will need to ask: If only part is required, what part, and what design or sequence changes are needed to effect this and are there better alternatives?

- What is the contractor is capable of achieving? The employer's objectives will clearly have to be counterbalanced against what these.

- What are the new defined date(s) for completion? This may also affect insurance and termination provisions.

- Are LAD provisions to be amended? It may be that a defined no-damages-for-delay grace period is to be provided after the new date for completion. Where sectional completion is introduced it may be that an entirely new delay damages regime is introduced with respect to each section of the works.

- How are the acceleration measures to be valued or reimbursed? This requires consideration of whether this is structured as a price that might be forfeited in whole or in part in the event of delayed completion, whether compensation is to be sectional, bonus arrangements, timing of payments. Alternatively consideration is required of the methods used to record additional costs incurred and mechanisms that might cap or limit additional costs incurred.

- Administrative issues. Consideration may be required of revisions to progress planning and measurement systems, revised reporting systems and subcontractor management systems.

B. A project manager's shortlist of actions:

- Ascertain which activities are resource limited, including space
- Ascertain lead-in periods for all resources, including design information
- Ascertain which activities are critical and near critical.
- Indentifying new workfaces and adding labour and plant to them
- Activity splitting
- Amending priorities: postpone non crucial work to later.
- Discuss alternative completion phases
- Working longer hours (Weekends and nights)
- Suggest alternative designs
- Assuming control of new issues: design detailing
- Assuming control of other works contractors
- Special position of indirect costs.

C. Draft heads of terms

The following is a checklist of issues that may need to be covered in a supplemental agreement:

- Noting, with some precision, progress achieved to date

- Noting, with some precision, claims for additional time made to date

- Revised Date(s) for completion and new phasing arrangements; This may include introduction of new sectional dates, which in turn requires definition of each section of the works

- Adjustment to Liquidated damages provisions. This may involve a no damages period, or new rates to correspond to new or varied sections of the works

- A definition of practical completion or statement of anticipated functionality at completion. This is particularly important with, for example, a retail unit that requires all works to be completed and defects rectified before trading commences.

- A statement of the basis upon which time claims have been settled. Amendments may also be required to the extension of time provisions for example, to vary the matters that constitute relevant events. If future delays are not to be processed under the contract's extension of time methodology, provisions will be required to set out alternative arrangements.

- Adjustments to contractual bonuses due; introduction of new or revised bonus provisions,

- Particulars of settlement, if achieved, of loss and expense claims in respect of delays already incurred.

- Valuation and payment provisions in respect of acceleration, whether lump sum or 'additional cost' arrangements.

- A formula or mechanism for adjusting the price upon contingent events

- Project controls provisions: provision of revised programmes and progress reports; cost information and reporting provisions.